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A BOTANICAL SURVEY OF SAN JACINTO MOUNTAIN

BY

HARVEY MONROE HALL

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A BOTANICAL SURVEY OF SAN JACINTO MOUNTAIN.*

INTRODUCTION.

Selection of San Jacinto Mountain.

Extending across Southern California in an irregular line from the point where the Sierras and the Coast Ranges meet, nearly to the southeastern corner of the state, a series of mountain ranges separate the dry interior deserts from a much more moist but still arid region bordering on the Pacific Ocean. Raising their summits above the lesser mountains and ridges of these ranges, a few peaks stand out like sentinels and serve as land-marks for all the surrounding country. The southernmost of these high peaks is San Jacinto Mountain which, with its altitude of 10,805 feet, is separated from all the others by low passes and ridges the highest of which is under 4000 feet in altitude.

In considering this mountain as a field for botanical exploration it was noticed that its position at the southern extremity of the higher ranges would make it the southern limit for many boreal species. It was also noted that the proximity of the Colorado Desert would give to its flora a strong austral element, and that its isolation from other mountains would render more definite certain problems connected with the geographic distribution of plants. For these reasons, as well as for a number of others of minor importance, San Jacinto Mountain was finally selected for botanical investigation.

Region Covered and Collections Made.

In the course of this survey practically all parts of the mountain, with the exception of a small area in the chaparral belt of

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the northeast side, were visited, and, although the entire region is considered in the chapters devoted to plant distribution, it is to be noted that only those species of plants found in or above the Yellow Pine belt are included in the list which closes this report.

Of the visits made to the mountain the first on which any extensive botanical collecting was done was in 1896, when about six weeks during the months of August and September were spent in botanizing principally over the south side, but a trip was also made through some of the higher valleys of the east side to the main peak. During this season the writer was accompanied by Mr. A. R. Morrison, who rendered valuable assistance in the collection and preparation of specimens. The next year four excursions were made to the mountain, beginning with May 1 and extending to the last of July. The first of these was to Fuller's mill, which has an altitude of 5800 feet, and as snow was then lying on the ground the advisability of confining our early collecting to the lower altitudes became apparent; but in July two visits were made to the region around the highest peaks and collections made. In 1898 a few days in the latter part of June and the first of July were spent botanizing along the south side and as far up as Strawberry Valley, and on this trip Toro and Santa Rosa Mountains, the southeastern continuation of San Jacinto, were visited for the second time. Practically the same ground was covered in 1899, but this time during the latter part of May.

From May 15 to June 1, 1901, a collecting trip in company with Professor W. L. Jepson was made to Strawberry Valley, Palm Cañon, Santa Rosa Mountain, and other localities to the south. The author of this paper then decided to make as thorough an exploration of the Flora of San Jacinto Mountain as time would permit. A camp was therefore established in Strawberry Valley, and between June 19 and August 7 all parts of the mountain above the chaparral belt were again gone over, collections of the flowering plants made, and notes on distribution and abundance taken. The results of this survey are given in the following pages.

Collections Made by Others.

A number of other botanists have visited the mountain from time to time and made more or less extensive collections. Mr. S. B. Parish, of San Bernardino, the first of these, made collections there in 1879 and again in 1880, 1881, and 1882; on the first and third trips spending about a week each time and visiting Strawberry and Tahquitz Valleys, the other times passing through Strawberry and Thomas Valleys en route to the regions lying farther south. On these trips a number of new species of plants were brought to light by this diligent botanist, *Euonymus Parishii* and *Eriogonum apiculatum* being the most noteworthy.

Dr. H. E. Hasse, of Soldiers Home, was on the mountain for a week in July of 1894, botanizing from Strawberry Valley at least as far up as the Tahquitz Meadows. In 1896 Dr. A. A. Davidson, of Los Angeles, spent some weeks collecting and taking notes in the vicinity of Strawberry Valley and also along the trail to the summit of the main peak, and Mr. George F. Reinhardt made a collection of San Jacinto plants in June, 1897, for the University of California. Mr. A. W. Anthony has also done some collecting in this region.

In May, 1901, Professor W. L. Jepson spent several days on the mountain botanizing around the south and east sides, and small collections were also made in this year by Mrs. F. C. R. Price and by Mr. O. P. Medsger.

The only papers dealing in any way with the flora of San Jacinto Mountain are two reports on the San Jacinto Forest Reserve,* prepared by Mr. J. B. Leiberg, after having inspected the condition of the forests in 1898. In these reports the principal trees and shrubs are discussed and estimates of the amount of timber of various sorts on different parts of the mountain given, together with other information bearing upon the forests included in the San Jacinto Reserve.

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* U. S. Geol. Surv., Nineteenth Annual Rept. 5, 351–357 (1899), also in the Twentieth Annual Rept. 5, 455–478 (1900).

It is thus seen that the only connection between the montane flora of San Jacinto with that of other mountains must be by way of the San Bernardino Range, from which it is separated by the deep but narrow San Gorgonio Pass.

TOPOGRAPHY.

Coming now to the mountain itself, it is seen that the main body lies in a north-and-south direction, culminating in a high, ridge-like mass, a mile and a half long on the summit, the northern end of which is capped by the main San Jacinto Peak, the other by Marion Peak. On the west side the descent is at first quite rapid, but the slopes, much cut by cañons and ridges, soon become less steep and extend to the North Fork of the San Jacinto River, beyond which the numerous foot-hills become gradually smaller and smaller until the plains are reached. On the east a rapid descent is made for some 2000 feet, when the slope becomes more gradual and the east-and-west ridges so round themselves as to enclose two important areas, namely, Round and Tahquitz Valleys, which thus form an immense terrace on the side of the mountain. Below these valleys, and at altitudes of from 6000 to 9000 feet, the slope drops abruptly off to the Colorado Desert, the fault on the northeast side being 8000 to 10,000 feet high.

Even greater than the contrast between the east and west sides is that between the north and south. Standing on the main peak one may look down the steep north slope to the western arm of the desert only a few miles away, while to the south the mountain is continued in a series of irregular ridges with Tahquitz Peak rising to an altitude of 8826 feet as the most prominent feature, and Santa Rosa Peak rising to 8720 feet in the continuation of the range twenty miles to the southeast. At middle altitudes of the south side are numerous valleys of more or less importance, ranging in size from those only a few acres in extent to the Thomas Valley with its area of nearly 4000 acres.

The cañons, on account of the changes produced in the climatic and other conditions by their presence, are of considerable importance. The south and west sides are much cut by

transverse cañons. The most important of these is that of the North Fork of the San Jacinto River, the west wall of which rises very rapidly while the east side is somewhat more gentle but still quite steep. The east arm, known as Dark Cañon, is an important branch heading just below the main peak of the mountain. The cañons of the north side are exceedingly steep in their upper portions, where the walls are largely of solid granite, but below they descend more gradually and all ultimately open into the main Snow Creek Cañon. On the east, those of the higher altitudes are of minor importance, but the lower half of this slope is gashed by steep cañons, the walls of which sometimes rise to a height of several thousand feet above the streams at their bases.

Soil and Climate.

The nature of the soil of any region exerts a profound influence on the character of the vegetation, but, on account of its uniformity, it plays a minor rôle in the distribution of plants on San Jacinto Mountain. On examination it is found to be composed almost entirely of decomposed granite with a small percentage of black mould near the surface, and is chiefly of a loose, gravelly texture.

But little limestone is found on the mountain proper, although there are several limestone quarries in the low foothills which continue the range to the west. Calciferous rocks are also said to occur along the eastern base, and they are by no means rare at various places along the south side, but the per cent of lime in the soil is nowhere so great as to materially affect the character of the vegetation. Being derived from granitic rock, in which the feldspars form an important ingredient, the soil is particularly rich in potash, while of the essential elements it is probably the most deficient in nitrogen, since the supply of humus, especially on the lower slopes, is very limited.

On account of the aridity of the surrounding regions the amount of humus in the soil of the lower foot-hills is almost imperceptible, but at higher altitudes the ground is constantly receiving deposits of pine needles and other organic matter, and consequently we here find a thin humus covering. At places

this becomes six to ten inches deep, but it is usually much less as it is destroyed whenever passed over by fire. This layer of organic matter is of importance not only as a source of humus, and therefore of nitrogen, but also because of its service in catching and retaining the water from snow and rains, thus reducing the amount of run-off.

Since the temperature will be considered in connection with the factors affecting plant distribution, and since reliable data concerning this subject are lacking, no thermometrical records ever having been kept on the mountain, the topic is not here discussed.

As the amount of precipitation is largely controlled by the temperature, we find that the higher portions of the mountain are much more frequently visited by showers and snow storms than the lower, and that the west side is less arid than the eastern. In the foot-hill region the rainfall is quite limited in amount and restricted almost entirely to the winter months, but throughout the belt of coniferous forest at middle altitudes the precipitation during the fall and spring is much more generous, besides which there are occasional thundershowers during the summer and heavy snowfall in winter, the snow often reaching a depth of three or four feet in Strawberry Valley. Where the slopes are covered with chaparral the water is well conserved, being compelled to percolate slowly through the soil, which is held in position by the numerous roots and acts as a water sponge. Of similar service but less efficient is the layer of decaying vegetable matter in the forested portions; but, wherever the slopes are unusually steep, and also where the forests have been removed, the amount of run-off is greatly increased, as is indicated by the numerous ravines and gullies on these areas.

On the upper parts of the mountain the rainfall is abundant and it has been reported that snow sometimes falls to a depth of fifteen feet on the higher summits. All the slopes above 9000 feet altitude, with the exception of the most exposed, are covered with snow from December to April, while in the steep cañons which descend to the north of the main peak it remains throughout the year. This abundant precipitation at the high altitudes

is of great importance, since a large percentage of it, percolating through the soil and rock strata of the mountain, reappears at lower altitudes, often in the form of springs, thus adding to the supply of moisture for those regions.

Geology.

Concerning the geology of San Jacinto Mountain but little is known since, so far as we are able to determine, no geologist has ever visited that region. It is probable, however, that it was formed simultaneously with the San Bernardino and San Gabriel Mountains, that is, during the middle Tertiary. Throughout the Quaternary and early Tertiary a large land mass occupied the region to the north and east of where these ranges now stand, and it was from this that the supply of material for the Southern California mountains was drawn. After these were formed, a series of faulting took place on their east and north sides, as is indicated by the steepness of those slopes facing the Colorado and Mohave Deserts.

The rock formation is almost exclusively granitic. At a few places, notably on portions of Chalk Hill, the rock is largely quartzite, while along some of the crests near Tahquitz Peak and also along the east side a limited amount of volcanic rock is found. Mica schists, gneiss, and some marble occur at a few places, but not in large enough quantities to be of any great importance. No limestone of any importance was found except in the lower foot-hills.

PLANT DISTRIBUTION ON SAN JACINTO MOUNTAIN.

The Life Zones.

Up to the present time the mapping of the life zones of North America has been carried on chiefly by the zoölogists, who have considered its utility not only to the naturalist but also to the farmer, since life zones run approximately parallel with crop zones*. It is evident that certain crops are adapted to certain

*cf Merriam, "Life Zones and Crop Zones of the United States," in U. S. Dept. Agr. Bull. ix. (1898).

zones and when it is known to what zone any locality belongs the crops which would probably best thrive there may be predicited, and much time and money, which would otherwise be spent in experimenting, may thus be saved.

But in the study of plant geography the botanist finds that he can make use of these life zones for another purpose. In giving the range of any species of plant there is, in our opinion, a decided gain in definiteness when it is placed in its proper zone, and we believe that this will be more and more appreciated as botanists come to give more attention to the subject. The statement, for example, that a particular species occurs throughout the Transition Zone is much more definite than the statement that it occurs between 5000 and 7000 feet altitude; since the belt between 5000 and 7000 feet on one mountain may, on account of its latitude, the proximity of desert areas, etc., be a sweltering, brush-covered slope, while on another it may be a cool, forested area, or, if far north, even a bleak mountaintop above timberline. In fact there is usually considerable difference between the climatic conditions of two places of equal altitude on the same mountain in case they are on opposite sides. On the other hand, the term "Transition Zone" always refers to a belt which is neither extremely hot nor extremely cold, where such conditions prevail, for example, as would produce forests of Yellow Pine or White Fir. It is chiefly for this purpose that the life zones of San Jacinto Mountain have been worked out and mapped (see plate ii), and continual reference to these zones will be found in the last chapter of this paper, where the ranges of the species occuring on the mountain are given.

Most botanists appreciate the need of some such designation of the floral belts which are found on all mountains, but a few have objected to the use of the term "zone" in this connection and would not place the plants of the higher mountains in the same group with those of the Arctic regions, for the reason that certain conditions, such as atmospheric pressure, are not exactly the same in the two places. Although the truth of this is realized still the difference is slight as compared with that between the various life zones themselves and also, since latitude may be taken into consideration when working in the far north or in the far

south, it need not interfere with the use of the life zones as they are now understood, nor with the use of the terms by which they are commonly designated. In working on the flora of California it has been found that the division of the montane region into life zones has been much more satisfactory than the use of the four "regions" as proposed by Schimper.*

Accepting then this division of the montane flora, we find five primary life zones completely encircling San Jacinto Mountain which, given in the order of their occurence as one ascends from the base, are as follows;

Upper Sonoran

Transition { Lower Transition
Upper Transition

Canadian

Hudsonian

Arctic-alpine.

For the altitudes over which each of these zones extends the reader is referred to the map of life zones (plate ii).

As pointed out by Coville†, the plants most valuable in determining floral zones are the perennials. This is not only because they are the most conspicuous and therefore the least likely to be overlooked, but also because annuals represent the conditions of but a single season of growth, the importance of this being clear when we consider that the conditions are likely to undergo considerable change from year to year. In the preparation of the list of species for each zone therefore all annuals have been excluded.

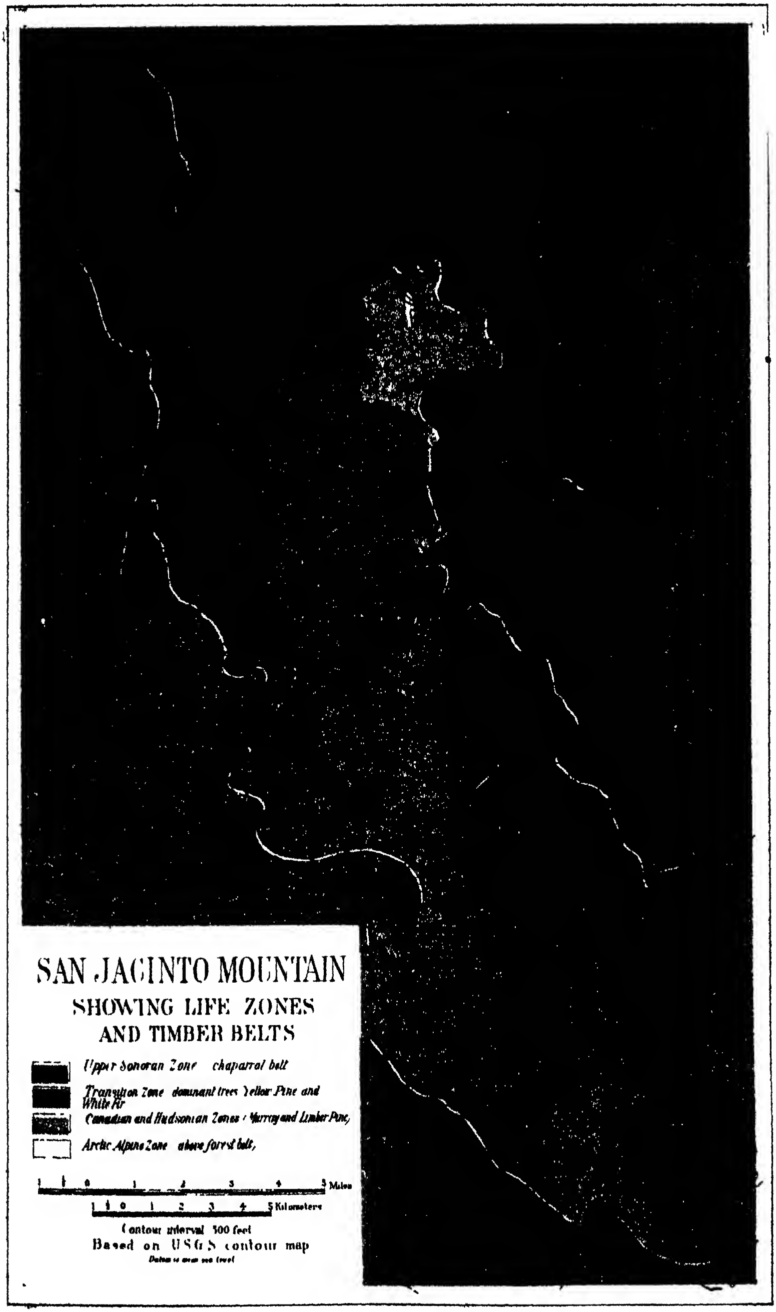
It is further to be noted that these lists are not intended to be complete, only the more characteristic plants being chosen. It is hoped that this will not only give an idea of the nature of the vegetation of each of the various zones but that it will also be an aid in working out the life zones on other mountains.

UPPER SONORAN ZONE.

San Jacinto Mountain is completely encircled by the Upper Sonoran Zone, which extends from its base to altitudes ranging

*A. F. W. Schimper, Pflanzengeographie 737 (1901).

†Contr. U. S. Nat. Herb. iv. 17-18 (1893).


SAN JACINTO MOUNTAIN
SHOWING LIFE ZONES
AND TIMBER BELTS
Upper Sonoran Zone chaparral belt
Transition Zone dominant trees Yellow Pine and White Fir
Canadian and Hudsonian Zones (Murray and Limber Pine)
Arctic Alpine Zone above forest belt
Miles
Kilometers
Contour interval 500 feet
Based on U.S.G.S. contour map

from 3000 to 7000 feet. At the eastern base it gives way to the Lower Sonoran of the Colorado Desert, but on the other sides it spreads out over an extensive foot-hill region except where bordered by the cultivated areas of the San Jacinto plains or of San Gorgonio Pass. The line marking the upper limits is extremely irregular since, by the effect of slope exposure, desert winds, and other factors it is carried well up into the body of the Transition at numerous places, while that zone makes not a few dips along the streams and where protected by ridges. Of the many species of shrubs which are characteristic of this zone the most useful as a zone indicator is the Chamisal (*Adenostoma fasciculatum*). The following also belong here:

PLANTS RESTRICTED TO THE UPPER SONORAN ZONE.

Adenostoma fasciculatum	Eschscholtzia Californica
A. sparsifolium	Lathyrus violaceus
Arctostaphylos tomentosa	Lotus glaber
Cercocarpus betulæfolius	Pentstemon antirrhinoides
Dendromecon rigidum	P. spectabilis
Dicentra chrysantha	Senecio Douglasii
Diplacus longiflorus	Solanum Xanti glabrescens
Echinocystis macrocarpa	Umbellularia Californica
Eriodictyon tomentosum	Eriogonum fasciculatum

TRANSITION ZONE.

The Transition is the largest and most important of all the zones on the mountain. As shown on the map of life zones (plate ii), it is comparatively wide on the west side, much less so on the east, and extremely narrow on the northeast. This is, of course, due to the peculiar topography. On the west the descent is rather steep, but quite uniform, while on the northeast there is a fault at about the upper limit of the Transition Zone. Round Valley has an altitude which places it in the Canadian, but from its northeast rim there is a sudden—almost vertical—drop of nearly 8000 feet to the barren Colorado Desert. Consequently it is but a short distance from the Canadian flora of Round Valley to the Sonoran flora of the desert side of the mountain. On the north side of the main peak this is carried to an extreme, there being an abrupt descent from the summit which, as will be shown, is within the Alpine Zone, to the western arm of the Colorado Desert, the flora of which is Lower

Sonoran. We thus have the six zones very much crowded together, and the upper four almost in superposition. There is probably no place in North America where the alpine and Sonoran floras are in such proximity as they are on San Jacinto Mountain.

In working on the flora of the mountain it very early became evident that the vegetation of the lower part of the Transition Zone was quite different from that of the upper part, and that the ranges of many species could be more concisely and definitely given by applying distinctive names to each of these parts. For this purpose the names *Lower Transition* and *Upper Transition* have been selected, but this will not preclude the use of the term *Transition* when it is desired to speak of the two parts taken as a whole. Whether or not this division will be of service in working out the distribution of plants on other mountains remains to be seen.

The line between the Upper and the Lower Transition is naturally not so distinct as those between the primary zones. On San Jacinto they may be distinguished by the presence or absence of certain trees and shrubs, among which the Yellow Pine and the White Fir are the most serviceable, the former being dominant in the Lower and the latter in the Upper Transition. We cannot depend entirely upon these two trees, however, to mark the two zones, since the fir is also present as scattered specimens in the Lower Transition, while the pine occurs at some places in the Upper Transition, although not as the dominant tree. While it must be admitted that the moisture conditions affect materially the distribution of these species, the fir requiring a moister soil than the pine, yet this is not an important consideration so far as their use as zone indicators on this mountain is concerned, since as the altitude becomes greater the temperature of the air is reduced and the moisture in the soil increased. Moreover the effect of such factors as slope exposure and desert winds is the opposite of that produced by an increase in altitude.

If it is desired to carry this distinction between the Upper and Lower Transition to other mountains it will probably be found necessary to resort to other species to indicate these zones, and it is partly for this purpose that a list of the shrubs characteristic of each is here inserted.

PLANTS RESTRICTED TO THE LOWER TRANSITION ZONE.

Arctostaphylos Pringlei drupacea	Libocedrus decurrens
Ceanothus integerrimus	Pinus Coulteri
Convolvulus villosus fulcratus	Potentilla glandulosa Nevadensis
Cornus Nuttallii	Prunus demissa
Eriodictyon Parryi	Pseudotsuga macrocarpa
Eriogonum stellatum	Quercus Californica
Euonymus Parishii	Ribes Nevadense
Fragaria Californica	Rhododendron occidentale
Hypericum formosum	Viola purpurea pinetorum
Kelloggia galioides	

PLANTS RESTRICTED TO THE UPPER TRANSITION ZONE.

Aster Andersonii	Philadelphus microphyllus
Eulophus Parishii	Selinum eryngiifolium
Gilia pungens Hookeri	Thalictrum Fendleri platycarpum
Panicularia nervata	Trifolium Rusbyi

CANADIAN AND HUDSONIAN ZONES.

It has seemed best to treat these two zones together since, as a result of the peculiar topography of the mountain, they are very narrow, and the line between them cannot be definitely drawn on account of the dearth of those characteristic species by which they are usually distinguished. Taken together they are found spreading out from the main peak over all the higher parts of the mountain, with the exception of a small patch on the very summit, which is occupied by the Alpine Zone, and extending down all the sides to altitudes of 8500 to 9000 feet, or running even lower on the cold north side and at a few other places. Tahquitz Peak, with its altitude of 8800 feet, bears on its summit a dilute Canadian flora which is connected to the main body only by a narrow band extending along the high ridge of which this peak is the culminating point.

Since the number of species of perennial plants restricted to these zones is somewhat limited, while there are not a few that are common to the Upper Transition and Canadian Zones, a list of those belonging to each of these groups is added.

PLANTS RESTRICTED TO THE UPPER TRANSITION AND CANADIAN ZONES.

Agrostis tenuis	Pedicularis semibarbata
Antennaria speciosa	Polygonum bistortoides
Dodecatheon alpinum	Potentilla lactea
Gilia pungens	Symphoricarpos Parishii
Monardella odoratissima	Veratrum speciosum

PLANTS RESTRICTED TO THE CANADIAN AND HUDSONIAN ZONES.

Carex Hallii	Poa alpina
Carex Nebraskensis	Ranunculus alismæfolius alismellus
Montia Chamissonis	Silene Parishii
Pinus flexilis	Stellaria crispa
P. Murrayana	Viola blanda

ALPINE ZONE.

The most southern latitude at which the flora of the Alpine Zone is known to occur in North America is on San Jacinto Mountain, where we find a few characteristic alpine plants growing along the banks of perpetual snow in the cool, shaded cañons which descend the north side of the main peak at altitudes of between 10,000 and 10,800 feet. Since, besides being very steep, these cañons are enclosed by rocky ridges the sides of which are nearly perpendicular, the exact determination of the boundaries of this zone was found to be no easy task, and it is not yet known just how far it extends down the north side, but this is probably not more than a few hundred feet. The species restricted to the Alpine Zone are *Oxyria digyna*, *Ranunculus Eschscholtzii*, *Carex Preslii*, and the alpine forms of *Spraguea umbellata* and *Aquilegia truncata*. Growing near these but more common in the lower zones occur *Silene Parishii*, *Draba corrugata*, *Heuchera rubescens* and a very depauperate form of *Holodiscus discolor dumosa*.

THE PHYTOGEOGRAPHIC FORMATIONS.

It is with great reluctance that the term "formation" is used in this paper. It has been applied in such various meanings by different botanists that it has become necessary for each author to state his definition of the term in order that intelligibility may be gained. Where here used it has the meaning as originally given to it by Grisebach in 1838.* He looked upon a phytogeographic formation (pflanzengeographische formation, vegetationsformation) as including "plants which may be very different, but which have properties and characters in common, which may be summed up by pointing out several species which exemplify the special characteristics of the whole."

* A. Grisebach, Ueber den Einfluss des Climas auf die Bergrenzung der natürlichen Floren, Linnæa xii. 160 (1838)

We now know that these formations are brought about by a combination of conditions to which each of the formation elements is adapted. Some would use the term in this ecological sense, and Schimper, in his great work on plant geography,* has recently defined it as an assemblage of plants determined by the qualities of the soil. But a formation may be determined by other conditions, such, for example, as those controlling the dissemination of seeds. Moreover in making a botanical survey of a region the plant formations first engage our attention and the inquiry as to the causes which have produced these formations naturally comes up later, and not until their nature is understood. It is therefore necessary to have some term by which to designate them, without any reference to their origin, and this is found in the term formation, used in its original meaning.

Some have limited the meaning of this term by using it to designate an assemblage of plants marked by a dominant species, instead of by a dominant physiognomic type. The value of this is not evident, and the practice of certain recent phytogeographers of dividing and subdividing each formation until scarcely more than a single species is left in each division is not followed in this paper. Wherever it has seemed advisable to discuss the individual species of a formation it has been done in the main part of the report, where they will be found arranged according to a well known system. The only departure from this rule is in the case of the Coniferæ, the species of which will for evident reasons be taken up in this chapter.

THE CHAPARRAL FORMATIONS.

On San Jacinto Mountain are found two distinct chaparral belts, the one belonging to the low, foot-hill region, the other to the higher slopes. These are distinct not only in composition but also in position, the species found growing in the one never occuring in the other, and for this reason it has seemed best to consider them as separate formations and of these the one of the foot-hills, which is indicated on the map of life zones by the purple coloring, will be first taken up.

*A. F. W. Schimper, Pflanzengeographie 175 (1898). See also Ch. Flahault on A Project for Phytogeographic Nomenclature, Bull. Torr. Club xxviii. 391 (1901), (translation).

On ascending the mountain from any one of the four sides a dense growth of chaparral is found covering all the lower slopes and completely occupying the Upper Sonoran Zone. On the north this belt is separated from a similar one of the San Bernardino Mountains only by a narrow strip, the San Gorgonio Pass, which flares out to the east to unite with the Colorado Desert. On the southeast it connects directly with the chaparral belt of the Toro Mountains, while to the south it spreads over a series of low hills, ultimately reaching the Palomar and Cuyamaca Mountains. On the west it is bounded by the low plains of the San Jacinto Valley. The mountain is thus seen to be completely surrounded by a brush covered area of considerable width, which separates the forests of its higher slopes from those of the other Southern California ranges.

On closer examination of this chaparral belt we find the principal shrub to be the Chamisal *(Adenostoma fasciculatum)* which covers the hills with almost impenetrable thickets often miles in extent, while growing with it but in less abundance are several species of Manzanita, Ceanothus, Yucca and, on shaded slopes, the Mountain Mahogany *(Cercocarpus betulæfolius)*, the Tree Poppy *(Dendromecon rigidum)* and other species.

Characteristic foot-hill annuals are abundant during the spring and early summer. The majority of these blossom in the shade of the higher bushes, some of them in small clearings, while, by the elongation of their stems and peduncles, a few ambitious species render their flowers conspicuous by carrying them above the sea of chaparral.

The plants of this belt exhibit strong xerophile characters, as, for example, in the reduction of the leaf surface, this being especially noticeable in the case of the Chamisal and of *Bebbia juncea*, while in the Manzanitas the same end is often attained by a twist in the petiole, the leaf being thus brought into a vertical position. Moreover in the shrubby species the leaves are nearly always thick and leathery, besides being often covered with a dense, woolly pubescence, as in *Sphæralcia ambigua*, *Eriodictyon tomentosum*, and others, while there is scarcely a glabrous plant to be found anywhere in the chaparral region.

An excellent opportunity of studying the root systems

was offered when, during the earthquake of December, 1900, a slope covered by chaparral and extending over some 600 acres suddenly sank for a depth of six to twelve feet leaving along its edges nearly vertical walls, thus exposing the roots of several species of shrubs while still in position. Here it was found that the roots of the Manzanita and Chamisal penetrated to a depth of from four to six feet,—a distance rendered necessary by the small amount of water present in the surface soil of these regions. Perhaps the most remarkable case of root development for the purpose of storing moisture is that of *Echinocystis macrocarpa*, or "Big-root", the roots of which are sometimes as large as a man's body and completely gorged with water.

The chaparral of the higher altitudes occurs only in isolated patches. Wherever the slope becomes too steep or the moisture too scant to support a forest formation, we find the chaparral coming in to take its place By far the most common species in these patches is the Shrubby Chinquapin, which covers quite considerable areas between the 8000 and 10,000-foot contours. Other species more or less common are *Ceanothus cordulatus*, *Cercocarpus ledifolius* and *Arctostaphylos patula*.

THE FORESTS.

While San Jacinto is surrounded on all sides by arid plains and its lower slopes clothed with chaparral the higher portions of the mountain are covered with extensive, somewhat open, forests of pine, fir and cedar. Some idea of the extent of these forests may be had by referring to the map of life zones (plate ii), where the area represented by the red and blue coloring is more or less densely forested, except where meadows occur. This area comprises about 75,000 acres, 70,000 acres being occupied by coniferous forest and the remainder chiefly by meadows within the forest belt. In general it may be said that the Transition Zone, colored blue on the map, is forested chiefly with Yellow and Sugar Pine and White Fir; the principal trees of the boreal region being the Murray and Limber Pines.

The various species of conifers comprising the forests are here taken up in the order of their occurrence on the mountain,

beginning with those of the lower edge of the timber belt and proceeding to those of the summit.

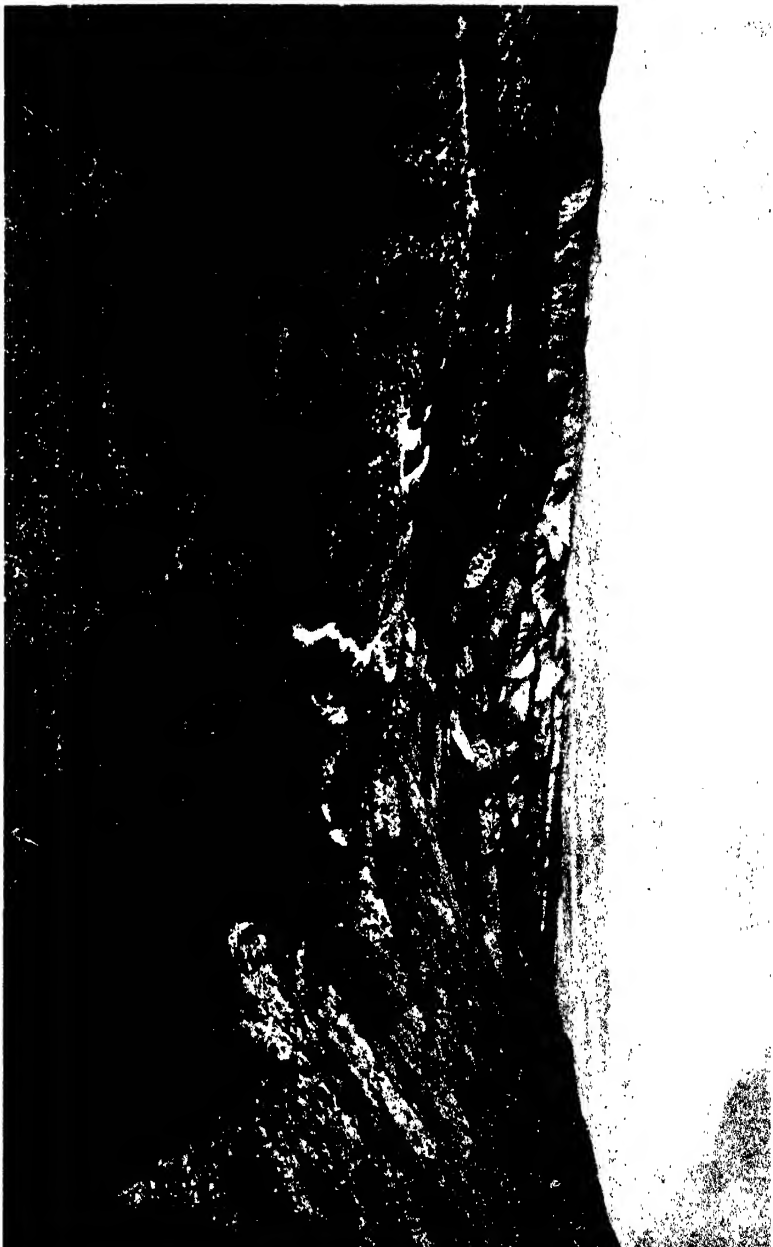
BIG-CONE SPRUCE (*Pseudotsuga macrocarpa.*)—The Big-cone Spruce, with its slender trunks and long, spreading branches, is found only in a few well watered cañons of the west side, below the range of the pines. It is common in the cañons of all three forks of the San Jacinto River, running down to an altitude of 3000 feet, but is entirely lacking in those cañons which open onto the Colorado Desert. That this species requires considerable moisture is shown by the way in which the individuals are huddled along the streams and on north slopes, often the south side and bottom of a cañon being forested with groves of the Big-cone Spruce, while the north side will support only a chaparral formation, as shown in plate iii, where the abrupt termination of the forest will also be noticed.

COULTER PINE (*Pinus Coulteri*).—This pine, remarkable for producing the largest cones known, is commonly met with on the south and west sides of the mountain, where it forms small groves and narrow strips along the lower edge of the Yellow Pine belt It is also found scattered among the other pines up to 6500 feet altitude on south slopes, but not in the higher valleys nor on those sides of the mountain facing the Colorado Desert. It has been reported* that the seeds, being large and rich, were eagerly sought by the Indians, who prized them as an article of food; but on account of their strong, oily taste, the Saboba and Santa Rosa Indians do not gather them. The nuts of the Piñon Pine (*P. monophylla*), which is abundant on the desert ranges to the southeast of San Jacinto Mountain, and of the Parry Piñon (*P. Parryana*), which grows sparingly in the neighborhood of Toro Mountain, are much preferred.

YELLOW PINE AND JEFFREY PINE (*Pinus ponderosa* and its variety *Jeffreyi*)†.—This characteristic Transition Zone pine is by

*Newberry, Pop Sci. Mo. xxxii, 35 (1887).

†Explanations of some of the irregularities in the boundaries of the Yellow Pine belt will be given in the discussion of Slope exposure, and desert winds. On the life zone map the blue area corresponds to the region in which either this pine or the White Fir is the dominant tree, except that in the canyon of the middle fork of the San Jacinto River the Big-cone Spruce is the principal tree, and that there is a narrow fringe of Coulter Pine along the lower edge on the west side. The White Fir becomes dominant only in the Upper Transition Zone.



LOWER EDGE OF CONIFEROUS FOREST. MIDDLE FORK SAN JACINTO RIVER

[illegible]

far the most prevalent conifer of San Jacinto Mountain. It forms the great bulk of the forest first encountered as one ascends from the foot-hills and completely encircles the mountain as a more or less distinct belt of varying width.

Owing to the comparatively gentle slope it forms on the west side a wide and magnificent forest area, the lower edge of which is quite definite and oscillates between the 4500 and 5000-foot contours in conformity with the steepness or direction of the slope, while a few specimens were found in cold, shaded cañons as low as 2500 feet. The upper edge is less definite, but lies between 8500 and 9000 feet, with a few patches at higher altitudes.

The lower limits of this belt on Fullers Ridge and on the north side of the main mountain have already been discussed. While on the northeast side it is very narrow on account of the sudden dip from the higher valleys to the steep, brushy slopes bordering the Colorado Desert, there is still room for a small grove of Jeffrey Pine in the east end of Round Valley at 8500 feet altitude, and a few scattered trees occur as far up as 9300 feet on south slopes. This is probably the highest recorded station for this pine.

In Tahquitz Valley are found the largest and most symmetrical specimens that grow on the mountain, extending from the isolated clusters at 9000 feet down through the magnificent groves of the main valley to an altitude of 6000 feet, where they abruptly give way to the chaparral formation of the lower slopes. On the south side the species runs up to 8800 feet on the open ridges. In Onstatt and Strawberry Valleys it forms open forests, in which are also found Sugar Pine, Incense Cedar, White Fir and Kellogg Oak, while the surrounding slopes are similarly forested, except where slope exposure or warm air currents prevent this, or where they have been denuded by man. A narrow fringe also occurs on the south side and around the upper end of Thomas Valley and sends tongues out into the drier parts of the meadow. In many of the trees on the borders of these meadows the trunks divide into two when about one hundred feet from the ground, the two branches continuing as erect shafts, but the cause of this unusual branching is not known.

It was first called to our attention by Professor Jepson, who has also noticed it in pines bordering certain meadows in the High Sierras.

The variety *Jeffreyi* is here treated with the true *P. ponderosa*, for the reason that they usually occur together, and the difference is sometimes so slight that it is impossible to distinguish them with certainty. Mature specimens of *P. ponderosa* are characterised by their large size, by their bark, which is in large plates, the deep-green foliage and the small cones, but young or half-grown specimens are very much like those of the variety. At the lower edge of the belt only the species occurs, in the great Yellow Pine belt of the middle altitudes we find them growing together, while along the upper limits of its range only the variety is found.

INCENSE CEDAR (*Libocedrus decurrens*).—The Cedar was found to be well distributed throughout the Lower Transition Zone, but being always scattered among other trees it nowhere becomes an important element in the forest formation. It requires more moisture than the Yellow Pine and is therefore restricted to the larger valleys and to the vicinity of streams, along one of which it was found descending to an altitude of 3500 feet. On the north side it runs down to the 4000-foot contour and on the east to 6000 feet, near the lower edge of the Transition Zone. It extends to near the upper limits of this zone in Tahquitz Valley, where it was seen growing at 8000 feet altitude.

SUGAR PINE (*Pinus Lambertiana*).—This pine begins at about 5000 feet altitude and extends from that contour nearly throughout the Transition Zone. It is very common and of large size along the trail that skirts the western side at about 6000 feet, but is less common both above and below that altitude, while on the southwest side of the Tahquitz-Strawberry Divide the Sugar Pine is the most abundant tree; but it is rarely met with in Tahquitz and Round Valleys, except on rocky slopes, which it seems to prefer. It is its frequent occurrence along the two principal trails, perhaps, that has led some to over-estimate the amount of Sugar Pine on the mountain.

On the high ridges that run out from Tahquitz Peak the trees

take on some peculiar forms, which are probably best accounted for by the altitude and the strong winds that sometimes sweep over that region. In one of these forms the dense, smooth bark is of a deep red color, the lower branches are given off from near the base and spread out over the rocks, while the leaves are only one and one-half to two inches long, scarcely one-half their usual length; but the cones, many of which may be reached from the ground, are of the usual shape and size. Another form approaches *P. monticola* in general appearance and in the characters of the cone but is plainly only a form of *P. Lambertiana*. It deserves further study in the field.

WHITE FIR (*Abies concolor*).—The White Fir is found throughout the Transition Zone except along its lower border. It begins as scattered individuals in the Lower Transition, becomes more and more common as the altitude increases, and is the dominant tree in the Upper Transition, where it forms more or less dense forests and even reaches over into the Canadian Zone where a few specimens were found scattered among the Murray Pines. The lowest point at which it was seen was at 4200 feet altitude in a shaded cañon; the highest was at 9700 feet on an exposed slope near the main peak. Nearly pure forests of this tree are met with in the upper part of the basin formed by Fullers Ridge and the spurs running north from San Jacinto Peak, and also on those slopes that form the south walls of Round and Tahquitz Valleys. There are a number of fir forests similar to these but of less extent. The fir requires a moister subsoil than either the Yellow or the Sugar Pine, which accounts for the fact that the forests mentioned above are all on the north sides of well watered ridges. It does not, however, demand so great a supply of moisture as does the Murray Pine.

MURRAY PINE (*Pinus Murrayana*).—This species, which is often called the "Lodge-pole" or "Tamarack" Pine, is the dominant tree of the boreal region. Its distribution may therefore be most readily learned by reference to the map of life zones (plate ii). The boreal area is not however entirely forested with this species, since a few exposed slopes are too deficient in moisture to favor its growth, and as a result we find in the lower part of the Canadian Zone a few straggling specimens

of the White Fir, while on the higher slopes the Limber Pine is very common, as noted below. The Murray Pine reaches its normal development in the well watered valleys of the higher part of the mountain, such, for example, as Round Valley and the small, pocket-like valleys between Deer Springs and the main peak, where this tree, with its straight, thin-barked trunks rising like collonades from the valley floors, forms quite dense forests of greater or less extent. Beneath these forests there is but little under-brush and the ground is thickly strewn with the small cones. Less symmetrical trees cover the drier slopes at high altitudes and run out along the north and east sides of the highest ridges. The undulating, rock-strewn plateau between San Jacinto and Marion Peaks, all of which has an altitude of over 10,000 feet, is scantily forested with both the Murray and Limber Pines. Here they take on those characters so common to trees growing under similar conditions,—the low, thick trunks, the twisted and gnarled branches reaching far out on the one side and scarcely present on the other, and the general dwarfed appearance always assumed by trees on exposed, wind-swept ridges at high altitudes. (See plate vi).

It was noticed that on certain slopes many of the trees were branched from near the ground, sometimes as many as six nearly erect trunks arising from a single base. This is probably due to a lack of soil moisture since it occurs only in trees growing along the edges of forests bordering on barren areas, while on the cooler slopes, kept moist by lingering snow-drifts, and in the basins and cañon bottoms the trunks are undivided.

LIMBER PINE (*Pinus flexilis*).—With the exception of the Murray Pine this is the only tree that inhabits the higher slopes and ridges of San Jacinto Mountain. It does not occur in the lower part of the range of that species and may be considered as a Hudsonian Zone species, as far as its distribution on this mountain is concerned, although it occasionally reaches over into the Canadian. It grows on the rocky summits just west of Lake Surprise, at 9200 feet altitude, and extends down the west side of Marion Peak nearly to Deer Springs. The lowest point at which it was found was on the ridge between Marion and Tahquitz Peaks, at an altitude of 8200 feet.

C NIFER S F REST STR ABERRY ALLEY

It is interesting to note the stations within the state reported for this species, the home of which is in the Rocky Mountains. It has been found on the Grapevine and Panimint Mountains in the eastern part of California,* on the Inyo Mountains,† in the San Bernardino‡ and San Jacinto Mountains, and on the very summit of Santa Rosa Peak,§ while in the Sierra Nevadas it has been found only at a few isolated stations, mostly on the eastern side and toward the southern end of the range.† It seems probable, therefore, that it has entered Southern California by way of the desert ranges, the highest peaks of which served as stepping stones between the Rocky Mountains and the higher ranges of middle and Southern California.

FOREST FIRES AND FOREST PROTECTION.—There has been, in recent years, no serious fire within the true forest belt of San Jacinto Mountain, although several thousand acres of chaparral covered slopes of the south side were swept by fire during the summer of 1900, and in July, 1901, another fire burned over some 3000 acres of heavily timbered land on the north slope of Fullers Ridge, which did not, however, kill many of the sound trees and was prevented, by the forest rangers and others, from extending to other parts of the mountain. While evidences of previous fires are present everywhere in the forest belt, but little damage was done to sound timber, and the greatest danger now seems to lie in the killing of young trees and in the destruction of the chaparral of the lower slopes.||

The worst enemy the forests have had has been, not the forest fire, but the sawmill. Many a pine-clad slope has been stripped of its best trees in order that they might be converted into lumber, and a very inferior quality of lumber at that. In the vicinity of Strawberry Valley about 4000 acres have been lumbered over and perhaps 2500 acres lying in the basin just

* Coville, Contr. U. S. Nat. Herb. iv. 221 (1893).

† Englemann, Bot. Calif. ii. 124 (1880.)

‡ Leiberg, in Nineteenth Annual Rept. U. S. G. S. 364 (1899).

§ Santa Rosa Peak has an altitude of 8720 ft. and lies 25 miles to the southeast of San Jacinto Peak. *Pinus flexilis* was first found on its summit by *W. L. Jepson*, in May, 1901.

|| For an account of the San Jacinto Forest Reserve see the Twentieth Annual Report of the U. S. Geological Survey, part 5, p. 455, et. seq. (1900).

south of Fullers Ridge. But this is a mere bagatelle as compared with the large forests, estimated at between 35,000 and 40,000 acres, still untouched. The Southern California Health Resort Company has recently acquired some 5000 acres in and around Strawberry Valley, and, being alive to their own interests, will protect not only the forests but also the shrubs, ferns and flowers to the best of their ability. The Florida Water Company is also protecting the timber on their holdings on the west side.

The great bulk of the forests, including all those of the higher valleys, is now in the government reserve, but each alternate section of this land has, until recently, been held either by the Southern Pacific Company or by individuals. The United States government is now extending its control by exchanging timber lands in other parts of the West, mostly in Oregon, for these tracts. This is a step in the right direction and would seem to indicate that the authorities realize the value of these forests to Southern California; although the fruit growers of the surrounding region, who are dependent on the mountain forests for their supply of water for irrigation purposes, have exhibited no great interest in the matter.

THE UNDERGROWTH.

We now come to a class of plants which are characteristic inhabitants of the open coniferous forests. These might have been taken up in connection with the forest formation but they are so distinct from the elements of the forest itself that they are here treated separately. Attention has already been called to the fact that the forests inhabit those slopes having comparatively little surface moisture. It therefore follows that the species comprising the undergrowth have their roots in dry soil and, as they are also subjected to the drying effects of the air currents which pass through the open forests, they take on a semi-xerophytic character.

The forests are largely free from underbrush and the shrubs are not therefore of great importance. In the higher valleys we find only *Symphoricarpos Parishii*, *Pentstemon Rothrockii* and a few less common species, but in the lower part of the pine belt the suffrutescent species are more commonly met with, *Arctosta-*

phylos Pringlei drupacea, *Ceanothus integerrimus* and *Rhamnus Californica tomentella* being the principal ones. In the east end of Tahquitz Valley patches of *Amorpha hispidula* and *Garrya Fremonti* are not rare beneath the pines.

The herbaceous undergrowth is more abundant and varied. The pine benches of the lower altitudes are sometimes red with the blossoms of *Pentstemon labrosus*, and *Monardella lanceolata* is scarcely less common. Other species are the following: *Streptanthus campestris*, *Arabis arcuata*, *Euphorbia Palmeri* and *Frasera Parryi*. All of these have tall, erect stems with long internodes and moderately small leaves. Quite different in general appearance are *Pedicularis semibarbata* and *Lotus Nedadensis*, the former with its elongated leaves spreading out almost in a rosette, the latter with long, prostrate stems. Other species of the open forest will be found listed in the main part of this report.

THE MEADOWS.

The chief prerequisite to a meadow formation is an abundance of surface moisture, and hence meadows of various sizes are found scattered over San Jacinto Mountain between the altitudes of 4000 and 10,000 feet wherever the surface soil is sufficiently moist. Where the moisture is principally in the subsoil coniferous forests abound, but wherever it rises nearly to the surface we find the forest giving way to a meadow formation. Sometimes the forest will send arms out into the meadow, but it will be noticed that these always follow strips of slightly greater elevation than the meadow land, the moisture still being, therefore, chiefly in the subsoil. Occasionally small patches of forest occur on knolls which are completely surrounded by meadow, thus giving rise to forest-islands, of which the one shown in plate v is an example.

The rise of soil moisture to the surface is brought about by the position of the underlying strata of the mountain. The position of these may be either of two distinct types, giving rise to two classes of meadow formations, namely, the hillside meadows and the valley meadows.

The hillside meadows receive their moisture from between

strata which come to the surface on the mountain side. Water from melting snow or from rains on the upper slopes percolates slowly through the soil and between the granitic strata of the mountain, to be released during the summer months at points farther down, the strata thus serving as reservoirs. By the crumpling or spreading of the strata it is often allowed to come to the surface, and wherever this occurs we find the small hillside bogs or the larger meadows so common on San Jacinto. Sometimes these are scarcely more than springs with the accompanying fringe of green, but more often they form conspicuous patches on the hillsides. There is one of these on the west side at about 8000 feet altitude that is large enough to be used as a landmark and can be seen for a distance of several miles, while in Tahquitz Valley meadows of this class are sometimes a mile long. The vegetation of the smaller hillside meadows is largely made up of true grasses, *Agrostis tenuis* and *Sporobolus gracillimus* predominating, with species of Bromus on the margins. Accompanying these are a number of the higher plants, among the more frequent of which are *Sisyrinchium bellum*, *Mimulus primuloides*, *M. Langsdorfii Tilingi* and *Rumex salicifolius*.

In the valley meadows the rise of moisture is due to the fact that the strata at the lower end of the valley are so placed that the water can escape only after it has risen to the surface. This may be brought about either by the convergence of those strata forming the valley walls, or the underlying strata of the valley floors may be curved upward at the mouth of the valley, thus assuming a transverse position and blocking the further passage of underground water. The soil is in most cases deep and rich since the valley floors have received the deposits brought in from the surrounding hills, and these meadows contain, besides the grasses, a number of important rushes and sedges, these sometimes becoming the dominant elements.

Of these meadows there are five which contain over one hundred acres. By far the largest and most valuable is the one occupying the middle portion of the Thomas, or Hemet, Valley at an average altitude of 4400 feet, this including about 2000 acres, all of which is used as pasturage for cattle. The water supply is derived from a high ridge, an off-shoot from Tahquitz

A FOREST ISLAND, TAHQUITZ VALLEY

Peak, on the north, and from the Thomas Mountains on the south, the moisture passing down these slopes through the subsoil and rock strata and rising sufficiently near the surface in the valley which they enclose to furnish the conditions favorable to a meadow formation. This meadow is composed largely of "wire grass" (*Juncus Mexicanus*) which is also the characteristic component of a number of the lower meadows where there is but a limited supply of moisture. Toward the lower end of the valley the water rises nearer the surface and the wire grass is replaced by true grasses, such as *Agropyron caninum*, *Elymus triticoides*, and *Polypogon Monspeliensis*.

In Onstatt Valley and at a few other places on the south side of the mountain there are meadows similar to the one in Thomas Valley. Besides these there occur at middle altitudes a few in which the grasses predominate, but it is not until we ascend to an altitude of about 8000 feet that meadows of any extent other than those composed of wire grass are found.

At this altitude we find, in Tahquitz Valley, a series of meadows ranging from the 9000-foot contour down to 6500 feet. Some of these are half-boggy hillside meadows while others are nearly level, the water being forced to the surface by the convergence of the strata forming the valley walls. Of the grasses, *Agrostis tenuis* and *Phleum alpinum* are the most abundant, the loose panicles of the former making large, red patches on the open meadows in August and September. In places where the soil contains but a moderate amount of moisture *Elymus glaucus* and *Bromus marginatus* are important elements, while *Panicularia nervata* is plentiful along the creeks below 7500 feet altitude.

In Round Valley, at an altitude of 9000 feet, occurs a meadow formation very different from that just described. Although the soil and moisture conditions are apparently the same as those which obtain in Tahquitz Valley, we here find the grasses replaced by *Carex Hallii* and *Carex Nebraskensis*, the meadow being composed almost entirely of these two sedges, while *Poa alpina*, the only grass which is at all common, grows in a few places. The change is undoubtedly the effect of the increased altitude, this meadow lying from 500 to 1000 feet

higher than the principal ones of Tahquitz Valley and well within the Canadian Zone, while the latter belong to the Upper Transition Zone.

We also find in Round Valley a number of small meadows which are on somewhat higher and therefore better drained soil than the one just described. These are composed entirely of the true grasses, *Elymus glaucus*, *Bromus marginatus seminudus* and *Sporobolus depauperatus* being the most important.

There are a number of plants other than grasses, sedges, etc., which find the conditions existing in the wet meadows of the higher valleys favorable to their growth. Since the soil in which they grow contains a large percentage of water, they take on a somewhat hydrophilous character, notwithstanding the fact that they are subjected to the drying effect of the direct rays of the sun. Of these plants the two most characteristic are *Polygonum bistortoides* and *Dodecatheon alpinum;* the former being common around the borders of meadows, where its white heads are quite showy during the flowering season, while the latter often dots the more boggy portions with reddish purple. Other species apparently restricted to this habitat are *Eulophus Parishii*, *Veronica serpyllifolia*, *Epilobium Oregonense gracillimum*, and *Aster Andersonii.* *Trifolium Rusbyi* forms a sod in one or two places in Tahquitz Valley, and *T. monanthum* is abundant around the borders of the Carex meadows of Round Valley, and elsewhere.

THE RIPARIAN FORMATION.

The riparian formation on San Jacinto Mountain is not a prominent one. The streams usually flow through cañons or valleys whose sides rise, either gradually or abruptly, from the very water's-edge, leaving scarcely room for a strip of saturated soil such as is common along streams of the lowlands. In some of the larger valleys, however, the flora of the stream banks becomes quite conspicuous.

In Strawberry and Onstatt Valleys the streams are lined with a growth of White Alder *(Alnus rhombifolia)* and two species of willow *(Salix lasiolepis* and *S. lævigata).* In the cañons the Western Azalea *(Rhododendron occidentale)* is found adorning

the streams and occasionally also the Common Dogwood (*Cornus pubescens*), but there are no shrubs or trees common to a majority of the streams.

Of the endogenous species a large percentage may be classed as riparian. The moist soil and the deep shade supply the conditions favorable to their growth, and as a result of these conditions they exhibit a more or less strongly developed hydrophilous character: the stems are often short, and the broad, thin leaves are commonly glabrous and sessile. Given in the order of their relative abundance, a few of the endogens are the following: *Lilium Parryi*, *Habenaria leucostachys*, *Veratrum speciosum*, *Epipactis gigantea*, and *Smilacina amplexicaulis*.

Growing with the above and scarcely less characteristic of the riparian formation are many annual exogenous plants, the majority of which are quite conspicuous, and of these *Aquilegia truncata*, *Castilleia miniata*, *Epilobium glaberrimum*, *Lotus oblongifolius*, and the different species of *Veronica* and *Thalictrum* are the more common and noticeable.

THE POND FORMATION.

Of even less importance than the riparian formation is the pond formation which, on account of the scarcity of bodies of quiet water, is almost lacking on the mountain. Hemet Lake is an artificial reservoir about two miles in length by less than a half mile in width, but the plants commonly inhabiting such places have not yet found their way to this body of water, and the only other one is a shallow pond about a quarter of a mile in diameter, known as Lake Surprise. This lies near the summit of a ridge at an altitude of 9000 feet and, being within the Canadian Zone, is surrounded with groves of Murray Pine. The somewhat stagnant water is much warmer than one would expect to find at this altitude and here *Potamogeton Claytoni*, which has not been found elsewhere in California south of the Yosemite, although it is common in the Atlantic states, grows in abundance, the surface of the water being nearly covered with its leaves in some places. *Eleocharis palustris* is also plentiful in the shallower portions, while along the edges *Limosella aquatica* is common both in the water and in the damp sand just above the water line.

THE CREST FORMATION.

In examining the flora of any of the high ridges of San Jacinto Mountain it very soon becomes evident that we are dealing with a type of vegetation quite different from that of any of the formations just discussed and, since it cannot be classed with any of these, we have decided to treat it as a distinct group, for which the name *crest formation* has been selected.

By the crest formation is meant that assemblage of plants, other than trees, found growing on the peaks and ridges above 7000 feet altitude. The plants of this formation are marked by a strong xerophile tendency brought about by the arid conditions under which they exist, this aridity being due to the low temperature, to the rapidity with which moisture is conducted to the lower portions of the mountain, to accelerated evaporation caused by diminished atmospheric pressure, and by the drying winds which sweep over those regions.

The shrubby vegetation is most abundant among the rocks, often springing from fissures in their sides, and is therefore obliged to resort to various devices for collecting and retaining the necessary amount of moisture. *Cercocarpus ledifolius* accomplishes this, in part, by a decided reduction in leaf surface and also by the thickening of the leaves and the development of a thick cuticular covering. When growing on the ridges the leaf surface in *Holodiscus discolor dumosa* is also much reduced. *Philadelphus serpyllifolius* and *Ericameria cuneata* have their leaves protected by an external covering, those of the former being silvery canescent beneath, of the latter being covered by a balsamic resin exuded by the leaf. In all these species the stems and twigs are exceedingly tough and wiry. Sometimes the shrubs venture out upon the exposed slopes, where they form a low, mat-like growth and connect directly with the chaparral formation of the higher altitudes, the principal species being *Castanea sempervirens*, *Ceanothus cordulatus* and *Arctostaphylos patula*.

The herbs of the crest formation are almost entirely perennials, not a single annual species being at all common on the higher ridges, and are largely confined to somewhat sheltered positions among the rocks where they seldom grow to a height of more than a few inches. The roots are more or less woody

SUMMIT OF SAN JACINTO MOUNTAIN

and well developed, as a result of the vigorous winds of these regions and the great depth to which they are obliged to penetrate in order to secure a sufficient amount of moisture, while the slender stems, which bear leaves provided with some device for the checking of excessive transpiration, die back each winter. Among the commoner species may be mentioned *Eriogonum saxatile*, *Silene Parishii*, *Gilia pungens*, and *Hieraceum horridum*.

Following now this formation along the ridges to the highest point on San Jacinto Mountain, we notice that the characters of the vegetation as described above undergo no radical change, but that they become more and more intensified as the altitude increases. As the summit, which has an altitude of 10,805 feet, is neared, it is seen to be covered with large rocks, the soil being scant and composed entirely of decomposed granite; while at places, especially on the north side, it drops off in steep cañons, the walls and bottoms of which are of almost solid rock. These cañons, continuing to descend very rapidly for over 7000 feet, soon reach altitudes of a more temperate climate, but in their upper portions small banks of snow remain throughout the summer, and along their margins a few alpine species of plants find the conditions favorable to their growth. On the other three sides of the peak the descent is much less rapid and here are found quite a number of boreal plants, the most conspicuous of which are the stunted specimens of the Limber and Murray Pines. Other species grow mainly in sheltered places, often in enclosures which are quite surrounded by rocky walls, and are all hardy, thick-rooted perennial herbs and shrubs.

Since the floras of isolated mountain peaks are always of interest, a list of the species found growing on the summit of San Jacinto Mountain, that is, between 10,700 and 10,805 feet altitude, has been prepared.

PLANTS OF THE SUMMIT OF SAN JACINTO MOUNTAIN.

Aquilegia truncata (alpine form)
Carex Preslii
Castanea chrysophylla
Draba corrugata
Heuchera rubescens
Holodiscus discolor dumosa
Monardella odoratissima
Oxyria digyna
Pedicularis semibarbata
Pinus flexilis
P. Murrayana
Ranunculus Eschscholtzii
Ribes cereum
R. lacustre molle
Silene Parishii
Spraguea umbellata (alpine form)
Trisetum subspicatum

The Factors Affecting Plant Distribution on San Jacinto Mountain.

ALTITUDE, TEMPERATURE, AND MOISTURE.

The most potent factor affecting the distribution of plants on San Jacinto Mountain is altitude. This may be said of all high mountains, since altitude exerts a direct influence on the temperature and moisture conditions of any region. On ascending a mountain which rises from an arid plain, as does the one under consideration, we should therefore expect to find a gradual change from a type of vegetation adapted to the hot, dry conditions of the lowlands to one suited to the cold, snow-covered slopes of the higher peaks. Thus we might expect to see the chaparral of the lower slopes giving way, at a uniform altitude on all parts of the mountain, to forests of Black Oak, Yellow Pine, and other species of both plants and animals ordinarily associated with these. At a definite altitude this belt would merge into one in which the White Fir would be the dominant tree, and this again into a belt of Murray Pine, and so on until the summit were reached.

Something like this is what we should expect to find on a mountain existing under ideal conditions. But other factors come in to mar this orderly succession of biological zones and, since the seemingly promiscuous distribution of plants on San Jacinto Mountain is due to these factors, they will be more fully treated in the following pages; while the more important factors of altitude, temperature, and moisture will not be further discussed, since their influence is more generally understood and since they usually act in the same direction.

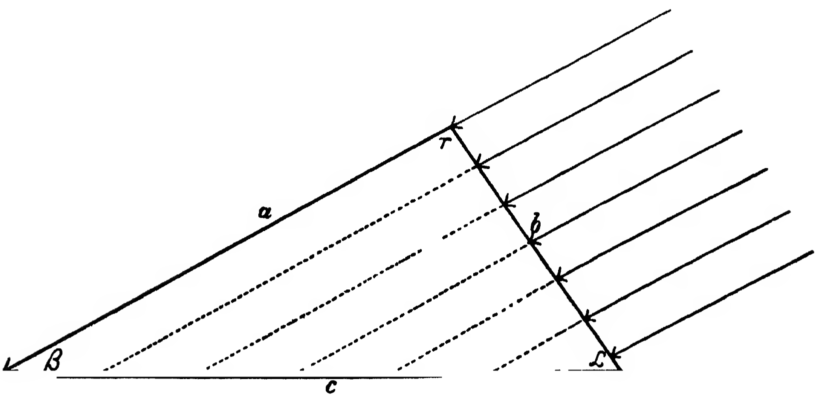
SLOPE EXPOSURE.

As is well known the inclination of a slope to the sun's rays during the warmest parts of the day may modify largely the amount of heat received and consequently the nature of the vegetation. As a result of this the life zones are forced up on south and west exposures while they dip down on north and east slopes.

Some idea of the extent to which slope exposure may affect the temperature of a surface may be had by calculating the ratio between the number of heat rays received by surfaces equal in

area but inclined at different angles to the direction of the rays. For this purpose a trigonometrical formula may be developed to give the ratio between the amount received by a surface inclined at any given angle to the level and a level surface of equal area, the sun's rays coming at any given angle.

Since the amount of heat received by a surface is proportional to its width we shall, for convenience, select a surface the width of which is equal to the diameter of a ray of heat. Moreover we shall consider only south slopes.



In the diagram let b be a surface, as indicated above, inclined at any given angle, $\angle$, to the level; let c be the level surface on which the rays would strike if not intercepted by b; β is any given angle at which the rays strike the level.

Now since the number of rays striking b is equal to the number that would strike c if not intercepted, we have

$$\frac{\text{Distance between rays on } b}{\text{Distance between rays on } c} \quad \frac{b}{c}$$

$$= \frac{\sin \beta}{\sin \gamma}$$

$$= \frac{\sin \beta}{\sin (180^\circ - \angle - \beta)},$$

or, since the amount of heat received by a surface is inversely proportional to the distance between the rays, we have

$$\frac{\text{Heat rec'd by unit area on } b}{\text{Heat rec'd by } \textit{equal area} \text{ on } c} = \frac{\sin (\angle + \beta)}{\sin \beta}$$

Applying this formula to the extreme case, where the rays strike the level at an angle of 45° and where the slope is inclined at an angle of 45° to the level (the rays thus striking the slope perpendicularly), we have the following:

$$\frac{\text{Heat rec'd by slope at } 45^\circ}{\text{Heat rec'd by equal area of level land}} = 1.414$$

In other words, if the sun is 45° above the southern horizon and a south slope is inclined at an angle of 45°, any area on the latter will receive nearly one and one-half times as much heat as will an equal area of level land.

The other extreme occurs on north slopes which, if inclined at an angle of 45° to the level, will receive no rays whatever as long as the sun is less than 45° above the southern horizon.

We must not, however, expect to find so marked an effect on the position of the life zones as the above figures would seem to indicate, since air currents and other factors are constantly tending to equalize the temperature of adjoining regions. If the two surfaces differ in character this must also be taken into consideration, since it would, in most cases, be accompanied by a difference in the coefficients of absorption. It is further to be noted that the ratio between the amount of heat absorbed and the amount reflected increases as the surface approaches to the normal of the incident rays, and that the absorbed heat affects primarily the temperature of the soil, while reflected heat affects primarily the temperature of the air.

Coming now to a consideration of slope exposure as affecting the distribution of plants on San Jacinto Mountain, we may take as examples a few of the more important cases. On making the ascent from the south side we pass first through a dense chaparral formation until, at about 5000 feet altitude, we come out upon the crests of east-and-west ridges, when the whole scene immediately changes, and we descend the cool north slopes beneath groves of Yellow Pine and Kellogg Oak. This change, which gives us a coniferous forest at even lower altitudes than the higher portions of the chaparral belt, is evidently due to a corresponding change in slope exposure, the chaparral occurring on slopes exposed to the south, the forest on slopes facing the north.

CH LK H L ND RI FE I

By reference to the map of life zones it will be seen that a long arm of the Upper Sonoran Zone, corresponding to the chaparral belt, enters the main body of the Transition Zone, or Yellow Pine belt, from the southeast. This chaparral area is a moderately steep slope facing the southwest, while in the more nearly level valleys below are open groves of Yellow Pine, the crest of the ridge above being also forested with this and other conifers. The raising of the chaparral belt is here due almost entirely to slope exposure, the slope being such as to be nearly at right angles to the incident rays of the sun during the hottest part of the day, while other factors scarcely enter in.

In some of these cases we find that slope exposure not only carries an arm of one zone well up into a higher one but that this intruding arm may be entirely cut off from the main body of the belt to which it belongs. A striking example of this is seen on Chalk Hill, a prominent south slope crossed by the stage road just before entering Strawberry Valley, where we have a case of a Sonoran, or foot-hill, flora being carried far above its normal position on the mountain and completely surrounded by a flora consisting of Transition species, thus producing a veritable Sonoran island (see plates vii and viii). The elevation of this slope ranges from 4400 to 5400 feet, and yet the flora is strictly that of the Upper Sonoran Zone, the most prominent species being *Arctostaphylos tomentosa*, *Adenostoma fasciculatum*, *A. sparsifolium*, *Castilleia foliolosa*, *Mimulus brevipes*, *Diplacus longiflorus* and *Cryptanthe Jonesii*, all of which are characteristic of the lower foot-hills. The Transition Zone species from above creep down along the creeks and in the shade of low ridges to unite with a large transition area at the foot of Chalk Hill. The presence of this transition flora is explained in part by the comparatively level surface and in part by the presence of a ridge which, rising to the south, intercepts the sun's rays during a part of the afternoon. This ridge supports on the slope facing the north, and thus opposite Chalk Hill, a vegetation consisting of such characteristically transition species as the Coulter and Yellow Pines. In the valley between this ridge and Chalk Hill we find the transition area mentioned above sending out arms

which reach up into the Sonoran Zone, the two floras mixing along the border.

The presence of the Sonoran island lying on the southeast slope of the ridge running out from Tahquitz Peak is due to a combination of factors. Besides the effect of slope exposure we have here to consider that of desert winds which, gliding over the ridge of which Antsell Rock is the most prominent feature, strike the slope under consideration, giving to it a warmer and drier climate than it would otherwise have.

Besides influencing the distribution of plants by its effect upon temperature, slope exposure may also act in a more indirect way by altering the moisture conditions. Toward the summit of San Jacinto Mountain are barren south slopes, to which the altitude gives a temperature sufficiently low to support forests in case the other conditions were favorable. This deficiency in trees can be explained in no other way than by the lack of moisture in the soil, since the only tree that could be expected at that altitude is the Murray Pine, which requires a moist subsoil and which is common on north exposures and on benches both above and below the slopes in question. The deficiency in soil moisture is undoubtedly due to the early melting of the snow on these south slopes from which the water quickly escapes, while on north exposures and on the benches the lingering snowdrifts act as reservoirs, and, by their slow melting, supply the soil with the necessary moisture.

The uniting of slope exposure with other factors to change the position of life zones will be discussed elsewhere.

EFFECT OF DESERT WINDS.

It is well known that the air currents which ascend a mountain are usually warm and tend to carry the life zones up, but in considering the air currents of San Jacinto Mountain we must distinguish between those coming from the west or southwest and those from the east or northeast,—between ocean breezes and desert winds. It is true that the former have crossed the warm San Jacinto Plains before reaching the mountain, but they are still much less torrid and drying than those ascending the east side from the Colorado Desert.

S NCR N SL NDS NE P CH LK HILL

The influence of these desert winds is similar to that of slope exposure and, coming as they do from the east and northeast, they carry the life zones up on those sides of the peaks and ridges where we should naturally expect to find them dipping. That warm winds may be more potent than slope exposure in their effect upon vegetation is shown by the fact that on the south and west slopes of the main mountain the lower limits of the Yellow Pine belt follows rather closely the 5000-foot contour line and dips considerably lower than that along the streams, while on the east side, just below Tahquitz and Round Valleys, it is carried up to about 6000 feet, and in some places even higher. In Tahquitz Valley the termination of the coniferous forest is exceedingly abrupt. We pass down the valley in the shade of Incense Cedars and Yellow Pines until an altitude of 6000 feet is reached, when the vegetation suddenly changes to that of the Upper Sonoran Zone, the most conspicuous perennials being *Adenostoma fasciculatum*, *A. sparsifolium*, *Diplacus longiflorus*, *Eriodictyon tomentosum* and *Nolina Parryi*. The abruptness of this change is due in part to the topography, the slope taking a sudden dip at this place.

A complicated case showing the effect of slope exposure, desert winds and protecting ridges, is the following. On the northwest side of San Jacinto Mountain is a basin known as Hurley Flat (alt. 3500 ft.) surrounded on the north and east by low spurs, on the southeast by considerably higher ridges, and on the south and southwest by a continuation of Fullers Ridge, which may be designated as Schains Ridge (alt. 5200 ft.). On the eastern wall of this basin (the west side of the low spur) the pine belt extends down nearly to the bottom. Along the south wall it creeps gradually up as we proceed westward, until on the southwest side of the basin (the northeast slope of Schains Ridge) there are no pines whatever. Passing over the summit of this ridge we find a narrow belt of conifers fringing its southwest side.

In searching for the cause of this peculiar distribution we notice the following. The eastern side of the basin is protected from desert winds by the low spur and is therefore able to support a scant coniferous growth; the winds glide over this

spur and strike the south and southwest sides of the basin, carrying the temperature line, and with it the lower edge of the pine belt, up on those slopes; the southwest side of Schains Ridge is again protected from desert winds and, although exposed to the direct rays of the sun during the hottest part of the day, it is fringed by a narrow belt of coniferous forest.

Besides the warm ascending currents we have also to consider the cold descending currents. During the night the cold air from Fullers Ridge and the higher mountains glides down their slopes and settles in the basin known as Hurley Flat, and it is asserted that on some nights there is a heavy frost at this place, while at Schains, 1700 feet above, it remains frostless. The fact that the bed-rock is near the surface at some places on the walls of this basin should perhaps be taken into account in case a detailed examination were to be made, but it does not affect the general results as noted above.

Numerous cases similar to that just described occur all along those slopes facing the Colorado Desert. It is thus seen that the presence of this hot, arid region exerts no small influence on the distribution of plants on San Jacinto Mountain.

ROCK SURFACE, AVALANCHES, AND LAND SLIDES.

But little of the surface of San Jacinto Mountain is devoid of all vegetation. Large areas on the west side of the high ridge connecting the main peak with Marion Peak are so closely covered with large rocks above the 9000-foot contour that one can scarcely make his way among them, yet wherever there is sufficient moisture we find forests of *Abies concolor*, *Pinus Murrayana*, or *P. flexilis*, depending on the altitude. There are, however, a few barren cliffs and rocks, some of the latter a thousand feet high, in the vicinity of Tahquitz Peak and along the great fault on the northeast. These stand out in bold relief from the forests which surround them.

Although there is scarcely sufficient snow on the mountain to cause serious avalanches, still the extreme steepness of the north side tends to their production. There have been a few of these which, tearing down the north and northwest faces of the main peak, plunged into the tributaries of Snow Creek Cañon, leaving

ROCK SURFACE AND FORESTS HEAD OF STRAWBERRY VALLEY

[illegible]

a white trail of bare granite in their rear. As the already too scant soil was carried completely away these areas were never reforested and remain as scars on the mountain side.

Somewhat similar are a few denuded slopes in the chaparral belt. In springtime the streams of the foot-hill cañons, swollen by water from the melting snow of the higher regions, undermine their banks and thus cause land slides on the steeper hills. The vegetation is carried down into the cañons, leaving only ragged areas of bare soil or rock where before were solid thickets of chaparral. Several such denuded areas are shown in the background of plate iii.

WATER COURSES.

As compared with those of more northern latitudes the streams of San Jacinto carry but a small volume of water, and yet, since they are found on all parts of the mountain, their influence on the distribution of plants is one worthy of consideration among the other factors. They all have their rise at considerable altitudes, the source of some being the numerous small springs, which open on the mountain sides, while others are fed from the banks of melting snow; but all the larger streams, with the exception of Snow Creek, receive their water from the half-boggy meadows of the higher valleys. The smaller streams soon unite to form about six fair-sized creeks and these, following the tortuous cañons which they have cut into the mountain side, either find their way to the main San Jacinto River and thence to the sea, or else, by turning easterly, flow out on the Colorado Desert, in the sands of which they are soon lost to view.

Among the effects produced upon the vegetation by the presence of these brooks the most obvious is that due to the increase of soil moisture along the banks. In rapidly flowing streams, such as we here have, this influence is not felt for any great distance from the stream, but it is sufficient to gather along the water courses a characteristic riparian formation, quite distinct from the forest formation of the drier slopes.

As affecting the position of the floral belts their influence is quite marked, the water having a cooling effect on the tempera-

ture during the day, while throughout the night time the cold air of the higher altitudes settles into the cañons through which they flow. As a result we find the life zones dipping along the streams and sometimes carried several hundred feet below their normal position. It is to be noted, however, that while this effect is nearly always one which may be easily determined, it is scarcely to be compared with that produced by some of the factors mentioned above, some of which are capable of shifting the life zones for a vertical distance of several thousand feet.

THE BATTLE OF THE FACTORS.

Having once determined the factors which affect the distribution of plants in any region, and having received some notion of the relative value of each of these, the next problem is the determination of the result produced by these factors when acting in all possible combinations. In attacking a phytogeographic problem there is a strong tendency to select only one or two factors and, centering the attention on these, to attempt the explanation of all phenomena connected with the subject by reference to these alone; but it is to be remembered that the flora of any region is determined by a number of factors, some of greater importance and some of less, but each to be considered as having its own influence on the common resultant.

A number of these factors often act to produce the same result, and whenever this occurs a marked effect upon the position of the floral belts is noticed. An instance of this is found along the North Fork of the San Jacinto River, where the effects of slope exposure and of the presence of a mountain stream act in unison against that of altitude. Here, as a result of the cooling effects produced by the stream and by the presence of Indian Hill which, rising on the west for some 2000 feet above the stream banks, shuts off the afternoon sun, we find the lower edge of the Yellow Pine belt dipping to an altitude of 3000 feet, while its normal position on San Jacinto Mountain is about 2000 feet higher.

A fierce battle of this nature is the one waged on the north side of the mountain where, on account of the steep north slopes, we should expect to see the life zones running down to

very low altitudes. But opposed to this factor is that of the warm air currents rising from the Colorado Desert. The lower edge of the timber belt, which furnishes a good indication of the results of the struggle, is seen to be extremely sinuous on these slopes, running well out on the protected sides of all ridges and spurs, but immediately retreating to higher altitudes wherever it comes around on those sides exposed to the desert winds. This would seem to indicate that the lower limits of this belt are influenced not so much by the slowly ascending air currents as by the hot winds, since the former would tend to equalize the temperature over all that region, while the latter strike as hot, drying blasts, on all exposed areas.

While the only factor to be considered in the case of the ideal mountain, as pictured in the opening section of this chapter, was that of altitude, it is now seen that in actual cases many other factors demand our consideration, and it is interesting to notice that these may be combined in such a manner that the effect of those acting in one direction will be neutralized by the effect of those acting in an opposite direction, the resultant thus being the same as though altitude were the only acting factor. But the slightest increase in the value of any one factor will immediately destroy the equilibrium and manifest itself in its effect on plant distribution. In this connection we may compare the conditions prevailing on the west side of San Jacinto Mountain with those of the east side. On the former the desert winds have but little influence, while slope exposure carries the lower edge of the timber belt up to an average altitude of 5000 feet; on the latter slope exposure may be considered as negative, since the slope is such that during the hottest part of the day the sun's rays strike it at only a very oblique angle, but desert winds here exert a pronounced influence, carrying the life zones even higher than did slope exposure on the west side, the lower edge of the timber belt being at 6000 feet altitude east of Tahquitz Valley and considerably higher on the northeast side. At a few places, however, a new factor comes in. This is the effect of cold streams, which, opposing that of desert winds, carries the timber belt some 500 feet lower along the creeks than it is on the drier slopes; but even after the north slope and the

streams have combined their forces in an attempt to reduce this line it is still 500 to 1000 feet higher than it is on the south and west sides.

From this we are led to conclude that the prime factor affecting the distribution of plants on San Jacinto Mountain is altitude (including with this other conditions produced by the altitude), and that second in importance, particularly on the north and east sides, is the influence of desert winds, while the third factor is slope exposure. We also see that these, together with other factors of less importance, unite in many sets of combinations on different parts of the mountain, thus producing in the floral belts a great diversity of outline and position.

A COMPARISON OF MONTANE AND DESERT CONDITIONS.

At first thought one might suppose that the conditions existing on high mountains and those prevailing in the desert regions were directly opposite in their nature, but when considered in the light of their effect upon the plants of the two regions it is seen that they are in many respects very similar.

An example of this similarity of characters in plants from the montane and desert regions, as contrasted with those of plants from the intervening slopes, is seen in the three varieties of *Monardella macrantha* collected in the San Jacinto Mountains and along the desert which skirts their eastern base.

In plate xii is shown a variety (the second one technically described under *Monardella macrantha* in the list closing this report) from the Upper Transition Zone. It grows in open pine and fir forests at about 8000 feet altitude, and may be considered as the high-montane form. Comparing this with the specimen shown in plate xi it is seen to be much reduced in size owing to the shortened internodes; the leaf surface is greatly reduced, the pubescence close and dense, and the whole appearance is that of a xerophytic plant.

The specimen shown in plate xi (*M. macrantha tenuiflora*) is from a shaded hillside just below the Lower Transition Zone and therefore in the upper part of the chaparral belt. This variety grows beneath larger plants by which it is partially shaded. The internodes are seen to be elongated, the leaves are much larger

than in the other varieties, the pubescense is sparse and straight, while the general appearance is that of a mesophytic plant. It will also be noticed that the spaces between the larger leaves are filled in by smaller ones borne on short, arrested branches, thus increasing the amount of leaf surface exposed to the sun.

In plate x is represented a specimen (the third variety technically described under *M. macrantha*) from the borders of the Colorado Desert, to the southeast of San Jacinto Mountain. The plant was in reality collected at a slightly higher altitude than the one figured in plate xi, but the hillside on which it grew opened out directly towards the desert so that it was in the Lower Sonoran Zone, where the conditions are decidedly arid. The characters exhibited by this plant are similar to those of the one figured in plate xii, from the highest altitudes, but the xerophytic nature is somewhat more pronounced.

On examining the internal structure of these plants we find variations in the histological characters running parallel with those of the external characters. Examinations have been made only of the leaves, cross sections of which are shown in plate xiii. It is seen that in the leaves of plants from the chaparral belt (fig. 1) the epidermis is composed of large cells with walls about one-half as thick as the diameter of the cavity, the loose tissue below the palisade layers of the mesophyll contains large air spaces, and the epidermal hairs are long, straight, and two-celled. In the leaves of plants from high altitudes (fig. 2) the structure is very similar to that found in leaves from the desert region (fig. 3), in each case the epidermal cells being small, with greatly thickened outer walls, the diameter of which is about twice that of the cell cavity, the air spaces being smaller and less common, and the epidermal hairs shorter, often bent or appressed and not infrequently only one-celled.

We find, then, on San Jacinto Mountain three varieties of *Monardella macrantha*, two of which are xerophytic and one mesophytic. One of the xerophytic forms comes from the desert region, the other from high altitudes in the montane region, while the mesophytic form occurs only at points between these two regions. From this it is evident that the conditions

prevailing on the higher mountains produce, to a large degree, characters similar to those which are found on desert plants.

On comparing the climatic conditions prevailing at high altitudes with those of the desert region we at once recall the vast difference in temperature; but it has been demonstrated by a series of experiments carried on by Bonnier* and others that the alpine vegetation is affected not so much by the extreme and continued low temperature as by the the fluctuation between warm days and cold nights. During the day the sun's rays give to the mountain tops a reasonable amount of heat but, as evening draws on, rapid radiation due to the rarified atmosphere sets in, and the temperature is suddenly and very appreciably lowered. Similar conditions prevail on the desert where excessively hot days are followed by cold nights, while at middle altitudes, especially on the forested areas, radiation is less rapid and the temperature more nearly uniform.

It is also to be noticed that plants of the higher montane regions adopt various devices for the accumulation of moisture and for protection against excessive transpiration. Sometimes the xerophytic characters which they exhibit are quite similar to those of desert plants: the root system is well developed, the stems and leaves are often clothed with a dense pubescence, and the leaf surface is reduced; while a histological examination shows an increase in schlerenchymatous tissue, a thickening of the outer walls of the epidermal cells, and comparatively few air spaces in the leaves. It is difficult to say how much of this is due to the lack of moisture and how much to other conditions, the most important of which are undoubtedly the fluctuation in temperature and the strong insolation.

As to the factors producing the arid conditions found on high mountains, it need merely to be noted that, in addition to the effect of a low temperature, which renders much of the moisture unavailable to the plant, the water early escapes from the surface soil, both as run-off and by percolation, and that as a result of the rarified atmosphere evaporation from the soil and from plants takes place very rapidly, while the constantly shifting air currents also accelerate evaporation to no small degree.

*Comptes Rendus cxxvii. 307 (1898).

MONARDELLA MACRANTHA ARIDA

FROM THE DESERT REGION CHARACTFRS XEROPHYTIC

MONARDELLA MACRANTHA TENUIFLORA

FROM INTERMEDIATE REGIONS. CHARACTERS MESOPHYTIC.

MONARDELLA MACRANTHA PINETORUM

FROM THE HIGH-MONTANE REGION; CHARACTERS XEROPHYTIC.

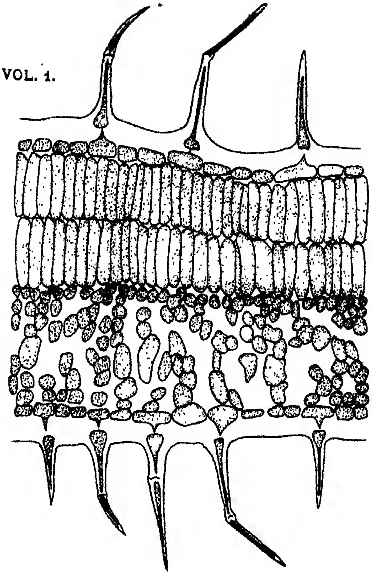


FIG. 2.

FIG. 3.

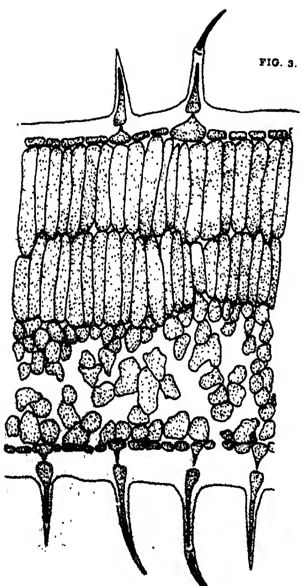


FIG. 1.

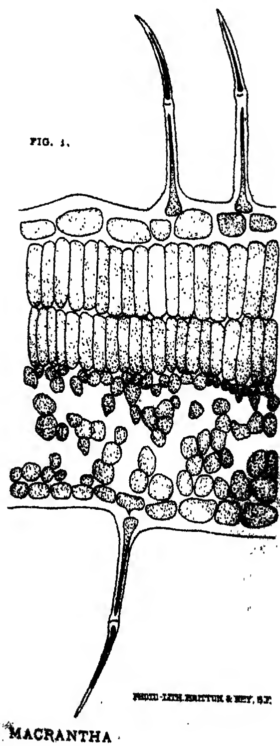


PHOTO-LITH. BRITTON & REY, S.F.

VARIETIES OF MONARDELLA MACRANTHA

CROSS SECTION OF LEAVES (ALL ×385)

ORIGIN AND AFFINITIES OF THE SAN JACINTO FLORA.

On examining the flora of the San Jacinto Mountains we find it to be composed of two quite distinct elements; the one plainly boreal in its character, the other austral. In the Transition Zone, which comprises the broad, middle belt on the mountain, these two floras intermingle and often lose something of their distinctive characteristics, so that it becomes difficult to say just where one terminates and the other begins. Since these were evidently derived from two different sources they are here separately considered.

THE BOREAL ELEMENT.

By taking a list of all the species of plants found growing in the Alpine, Hudsonian and Canadian Zones of San Jacinto Mountain we have a very good representation of the flora of the higher mountains of Southern California. A list of these, which has been prepared but which it is not necessary to reproduce here, shows that there are 129 such species represented and that of this number 10 species are limited to Southern California, 5 are restricted to Southern California, Arizona, and New Mexico, and 15 are generally distributed over the Northern Hemisphere; while the remaining 99 are common to the mountains of Southern California and the Sierra Nevadas. By adding the 15 species of general distribution to the last number, we have 114 species or about 88% of the flora of the higher portion of San Jacinto Mountain represented in the Sierras. Of these 114 species at least 46 occur also in the Rocky Mountains. It is therefore evident that the boreal flora of San Jacinto Mountain has its affinities with the flora of the high ranges extending northward throughout the state and, through this, with the flora of the Rocky Mountains.

In this connection it is instructive to compare the San Jacinto flora with that of the San Bernardino Mountains, since it would seem probable that any northern species reaching the former would pass by way of the latter. Of the 114 boreal species selected above as being common to the San Jacinto Mountains

and the Sierras, all but 18 have also been found in the San Bernardino Mountains, and this number is sure to be even farther reduced when that range shall have been more thoroughly explored. But from this it is not to be inferred that there are only 18 species common to San Jacinto and the Sierras which are not represented in the San Bernardino Mountains, for this number is taken from the already small list of those species selected as representing the boreal flora, and not from the entire list of San Jacinto Mountain plants. On the other hand, a much larger number of Sierran species, perhaps about four times as many, have been collected on the San Bernardino Mountains which do not occur on San Jacinto. This would seem to indicate that, if the high-montane flora of Southern California has been derived from some northern source, many species were unable to cross the barrier formed by the San Gorgonio Pass, and therefore found the southern limit of their range in the San Bernardino Mountains, or, if they did succeed in crossing over to San Jacinto, that they have become extinct on this mountain.

We have next to consider the probable conditions under which so large a number of boreal species entered Southern California. At the present time we find a series of mountain ranges extending from the High Sierras to San Jacinto Mountain,—everywhere high enough to support coniferous forests except where broken through by passes. Of these, three are so low that the montane flora is divided by strips of the Sonoran, this occurring at the San Gorgonio and Cajon Passes and at the low country between the Sierra Madre Mountains and the southern extremity of the Sierras; the last, which includes Soledad and Tehachapi Passes, being the most serious barrier to the southward migration of Sierran species.

It is possible that the montane flora has been able to cross these gaps. This, however, seems hardly probable, when we consider that alpine conditions are nowhere present between the highest peaks of the San Jacinto and San Bernardino Mountains and the southern High Sierras, a distance of something over one hundred miles. It is also to be noted that this explanation would not account for the presence in Southern California of the large number of Rocky Mountain species, since the Sierras have

had no connection with the Rockies by intervening ranges since Triassic times, and therefore not since our present flora was developed.

The presence of the northern forms on the higher mountains of the southwestern part of the United States is probably best accounted for by a theory advanced by Asa Gray in 1878,* according to which all the species normally occurring in the Arctic regions were compelled to migrate southward during the glacial period, on account of the great reduction in temperature. Geologists tell us that in California extensive glaciers extended at least as far south as the southern High Sierras, and it may well be imagined that the climate in Southern California must then have been much less temperate than at the present time, and therefore better adapted to a boreal flora. At the close of the glacial period the conditions were reversed and the boreal species, now finding the climate gradually growing warmer, were forced to retreat to colder regions and therefore not only migrated to the north but also "took to the mountains," where they found at the higher altitudes a set of conditions somewhat similar to those of their northern home. Here many species have continued to exist up to the present time without undergoing any great change; others, finding the conditions unsuited to their growth, have been forced out, while a few have taken on a more or less modified form, thus adapting themselves to their new environment. This may possibly account for the presence of certain high-mountain species which are found only in Southern California but which are represented in the Sierras by closely related species. Thus it was that certain boreal species of plants were stranded on the highest mountains and that we find many which are common to the higher peaks of Southern California, Arizona, and New Mexico, from which they extend along the crests of the Sierra Nevada and Rocky Mountains to the Arctic regions.

* "Forest Geography and Archæology," a lecture delivered before the Harvard University Natural History Society, Apr. 18, 1878, by Asa Gray. Printed in Am. Journ. Sci. & Arts, cxvi. 85–94, 183–196 (1878); also in Bull. U. S. G. S. vi. 62 (1882).

THE AUSTRAL ELEMENT.

Covering all the lower slopes and running well up into the Transition Zone is found a flora very different in character and affinities from that just discussed. The plants are remarkable in their adaptation to an arid environment, and therefore approach those of the desert regions in this respect. In fact many of the species extend well out along the low ranges of the Colorado Desert, and there can be little doubt that the floras of these two regions are closely related. Since so little is known of the flora of southeastern California and northern Mexico it is impossible to give the actual number of San Jacinto plants occurring in either of these regions, but it is probable that quite a number of species are common to all three.

Besides the strictly austral element, many of the foot-hill species are restricted to Southern California. These are often quite common and well distributed throughout the foot-hill region of the southern part of the state and, although they have probably migrated somewhat in past ages, still we may consider them as native Southern Californian plants.

THE PRESENCE OF ARIZONAN AND NEW MEXICAN SPECIES.

There still remain for consideration a few plants which apparently have no affinity with any other Californian flora, but which occur in the mountains of either Arizona or New Mexico or both. These are *Philadelphus serpyllifolius*, *Pentstemon Rothrockii*, *Geranium Fremontii*, *Trifolium Rusbyi* and *Lilium Parryi*, the first three of which have not yet been found elsewhere in California, while the last two have also been collected in the San Bernardino Mountains. With the exception of the last, which runs down into the Lower Transition, all are restricted in their range to the Canadian and Upper Transition Zones, and therefore cannot possibly connect with those of Arizona and New Mexico by way of the desert ranges. We are then confronted with the question as to the manner in which these entered Southern California or, in case they originated here, by what route they have been able to cross over into Arizona and New Mexico.

There are two possible solutions to this problem. The first is that the seeds may have been carried across the desert, in either the one direction or the other, by birds or other animals. It must be remembered, however, that the distance from the San Jacinto Mountains to those of Arizona is something over two hundred miles, that the seeds of these species have no particular devices to aid in their dissemination, and that seeds peculiarly adapted to dissemination over large areas have not been able to cross this barrier.

The second and more probable explanation is that we here have the remnants of boreal species which were driven from their northern home during the glacial period and which, being for some reason unable to retreat to the north at the close of that period, became stranded on these widely separated mountains, to which they had flown for protection from a climate gradually increasing in warmth and aridity. It is to be noted that one of these plants, the Geranium, occurs in the Rocky Mountains at least as far north as Idaho and further exploration may extend the ranges of all of them along both the Rockies and the Sierras.

We may then conclude that the flora of San Jacinto Mountain is composed of a boreal and an austral element, that the presence of the former is due to the fact that northern species were forced southward along the Sierra Nevada and San Bernardino Mountains during the glacial period, while of the species belonging to the latter a part are native to Southern California and a part have been derived from the regions lying to the southeast.

CATALOGUE OF SPECIES COLLECTED IN OR ABOVE THE YELLOW PINE BELT.

In preparing this list of San Jacinto Mountain plants, it has seemed advisable to exclude the foot-hill flora, since it is so largely composed of species more or less common in similar regions throughout Southern California; therefore only those species occuring in or above the Yellow Pine belt have been listed. It is to be noted, however, that foot-hill species are included if they occur on any of the "Sonoran islands," that is,

on slopes covered by shrubs belonging to the chaparral belt, or Sonoran Zone, but surrounded by coniferous forests. The distributional notes will, it is hoped, prevent confusing these with the truly montane species.

The generic nomenclature is, with very few exceptions, that of Engler & Prantl's Natürlichen Pflanzenfamilien; for the specific names adopted the writer is alone responsible. No attempt has been made to include an extensive synonomy, only the more important synonyms being admitted. As a rule, neither synonyms nor citations are given when they may be readily found by consulting such standard works as the Synoptical Flora* or the Botany of California.†

In the preparation of this catalogue the author is under great obligations to Professor W. L. Jepson, of the University of California, for valuable suggestions and continued help on many difficult problems; to Mr. Joseph Burtt Davy, of the same institution, for the determination of the Gramineæ and for critical notes on certain species of this family; and to Mr. S. B. Parish, of San Bernardino, whose knowledge of the Southern California Flora has rendered his assistance of particular value. It is a pleasure to also acknowledge the kindness of Dr. A. A. Davidson, of Mrs. Katharine Brandegee, and of Miss Alice Eastwood, in the loan of specimens for examination and in the extension of other courtesies.

CONIFERÆ.

Abies concolor *Lindley & Gordon*, Journ. Hort. Soc. Lond. v. 210 (1850). *A. concolor Lowiana* LEMMON, West Am. Coneb. ed. 3, 64 (1895). White Fir.

The White Fir is the dominant tree of the Upper Transition Zone, where it occurs in rather dense forests at 7000–8000 ft. alt., and is also found scattered throughout the Lower Transition on the one hand and in the lower part of the Canadian on the other. (See p. 23.)

* Synoptical Flora of North America, by Asa Gray, continued by B. L. Robinson, Vol. i. pt. 1, fascicles 1, 2 (1895–1897), Vol. i. pt. 2 (1886), and Vol. ii, pt. 1 (1886).

† Geological Survey of California, Botany, by Asa Gray, W. H. Brewer, and Sereno Watson, 2 vols. (1880).

Libocedrus decurrens *Torr.* Incense Cedar.

Commonly met with from the lower edge of the pine belt up to about 8000 ft. alt., but it is nowhere abundant. (See p. 22.)

Pinus Coulteri *Don.* Coulter Pine.

This pine is not rare along the lower edge of the forest belt on the south and west sides and sometimes runs well up into the forests of Yellow Pine, being found as high as 7500 ft. alt., above Strawberry Valley; but is evidently not suited to the more arid conditions of those slopes which face the desert as it was not found on the north and east sides. (See p. 20.)

Pinus flexilis *James.* Limber Pine.

The dominant tree on the high slopes and ridges around San Jacinto and Marion Peaks; also plentiful on Tahquitz Peak. It was found as low as 8200 ft. alt., but it is less common in the lower part of its range. (See pp. 24–25.)

Pinus Lambertiana *Dougl.* Sugar Pine.

The Sugar Pine ranges from an altitude of 5000 ft. to the upper limits of the Transition Zone, usually in scattered patches but occasionally forming small groves. (See p. 22.)

Pinus Murrayana *Murr.* *P. contorta Murrayana* ENGELM. Murray Pine. Lodge Pole Pine.

This is the characteristic pine of the Canadian Zone but also ranges throughout the Hudsonian and is plentiful on the highest ridges. Its altitudinal range on San Jacinto is from 8000 to 10,800 ft. (See pp. 23–24.)

Pinus ponderosa *Laws.* Yellow Pine.

The Yellow Pine is by far the most abundant and important tree on the mountain, where it occupies the Transition Zone, being the dominant tree in the Lower Transition and exceeded in numbers in the Upper Transition only by the White Fir. (See pp. 20–22.)

Pinus ponderosa Jeffreyi (*Murr.*) *Vas.* U. S. Dept. Agr. Rept., 1875, 179. *P. Jeffreyi* MURR., Rept. Oreg. Exped. ii. t. 1 (1853). Jeffrey Pine.

This variety is usually found at higher altitudes than the last, ranging from 5200 ft. to 9300 ft. alt. (See pp. 20–22.)

Pseudotsuga macrocarpa (*Torr.*) *Lemmon.* Big-cone Spruce.

Common in well watered cañons of the west side just below the Yellow Pine belt. (See p. 20.)

POTAMOGETONACEÆ.

Potamogeton Claytoni *Tuckerm.* Pondweed.

Collected only in the quiet waters of Lake Surprise, altitude 9000 ft., where it is abundant. (No. 2490.)

GRAMINEÆ.

[NOTE.—For the determination of the plants of this difficult order the author is under obligations to Mr. Joseph Burtt Davy, of the University of California. Wherever a new species or variety is described, the author of the new name is also author of the description and notes following.]

Agropyron tenerum *Vas.* Slender Wheat-grass.

Collected in Dark Cañon at 7000 ft. alt. (No. 2569.)

Agropyron caninum *L.*

Thomas Valley, at 4500 ft. alt.; Fullers Ridge, at 7000 ft. alt. (Nos. 2174, 2555.)

Agropyron Parishii læve *Scribn. & Smith*, U. S. Dept. Agr. Agros. Bull. iv. 28 (1897) (?)

A grass which is probably of this variety was collected in imperfect condition on the West Fork of Snow Creek at about 5000 ft. alt. (No. 2541.)

Agrostis Diegoensis *Vas.*, Bull. Torr. Club xiii. 55 (1886). San Diego Bent-grass.

On hillsides beneath the pines and also on stream banks at 5000–6000 ft. alt. (Nos. 2209, 2375.)

Agrostis tenuis *Vas.*, Bull. Torr. Club x. 21 (1883).

This delicate grass is plentiful in meadows and around springs at 7500–9000 ft. alt., wherever there is abundant moisture. In some of the Tahquitz meadows it is the dominant grass. (Nos. 2363, 2476, 2533, 2570.)

Agrostis verticillata *Vill.* Water Bent-grass.

Along water courses in the lower part of the pine belt of the south and west sides. (Nos. 2252, 2275.)

Bromus carinatus *H. & A.*

Common in all the forests of the south and west sides at 5000–6000 ft. alt. This is an important grass of the stock ranges of the south side since it matures earlier than the meadow grasses and is much relished by stock. (No. 2226.)

Bromus marginatus *Nees.*

Collected on wooded slopes of the south side at 4400 ft. alt. and also in Tahquitz Valley at 7000 ft., where it is plentiful near the streams. (Nos. 2033, 2462.)

Bromus marginatus latior *Shear*, U. S. Dept. Agr. Agros. Bull. xxiii. 55 (1900).

Found only in the vicinity of Chalk Hill at an altitude of 5000 ft. (No. 2099.)

Bromus marginatus seminudus *Shear*, U. S. Dept. Agr. Agros. Bull. xxiii. 55 (1900).

This is by far the most abundant Bromus on the higher parts of the mountain, being common both in the drier portions of the meadows and on rocky hillsides. At the eastern base of San Jacinto Peak it reaches at altitude of 9600 ft., the specimens here being less than 16 in. high. (Nos. 785, 2407, 2498, 2408, 2342.)

Bromus Orcuttianus *Vas.*, Bot. Gaz. x. 223 (1885).

Not rare in the lower part of the pine belt. (Nos. 2301, 2538.)

Bromus Orcuttianus grandis *Shear*, U. S. Dept. Agr. Agros. Bull. xxiii. 43 (1900).

Collected at 5300 ft. alt. on Fullers Ridge, in the same general region as the species. (No. 2256.)

Bromus Porteri assimilis *Davy*, var. nov. *B. Porteri lanatipes* SHEAR, U. S. Dept. Agr. Agros. Bull. xxiii. 37 (1900), in part. Mountain Brome.

Loosely tufted perennial; stems stout or slender, 7½ to 9 dm. high, puberulent: sheaths densely retrorse-pubescent; ligule 1 to 2 mm. long, truncate, lacerate; blades flat, 10 to 23 cm. long, 5

to 10 mm. wide, pubescent on both surfaces: panicle long-exserted, 1 to 2 or rarely even 3 dm. long, drooping but usually not heavy, the rachis branches and pedicels puberulent throughout; branches mostly in pairs below, long, slender, spreading or reflexed, bearing 1 to 3 or sometimes several spikelets near the end, remote, the lowest 2½ to 8 cm. apart: spikelets 28 to 40 mm. long, narrow, sub-terte, 6- to 11-flowered; empty glumes unequal, acute, 3-nerved, pubescent, the lower 6 mm. the upper 8 mm. long; flowering glume densely pubescent except at the extreme apex with appressed hairs, obtuse, terminating in a short awn 4 to 5 mm. long.

Type locality: "Wooded slopes and benches of the south side of the San Jacinto Mts., at 5300 ft. alt., June, 1901." H. M. Hall, no. 2228. Type specimen in the Herbarium of the University of California.

Range: Cañons and wooded slopes of the San Jacinto and San Bernardino Mts.; San Bernardino Mts., Waterman's Cañon, May 29, 1888 (S. B. Parish), and mouth of Snow Cañon, 5500 ft. alt., June 20, 1901 (S. B. Parish, no. 5038).

This is undoubtedly the plant referred to by Shear, under his original description of *B. Porteri lanatipes*, as not being typical of that variety and as approaching *B. lævipes*; he cites S. B. Parish nos. 253 and 2533a, and S. B. and W. F. Parish no. 1535, from the San Bernardino Mts. The Californian plant differs from *B. Porteri lanatipes* of the Rocky Mt. region in its less densely pubescent sheaths (described as "densely soft-downy or woolly,") and the greater pubescence of the stems, leaf-blades, pedicels, and empty glumes. From *B. vulgaris*, which ranges from middle California north to British Columbia, it differs in its 3-nerved lower empty glume and more obtuse flowering glume, the longer and more abundant pubesence on both, and the shorter awn. It appears to approach more nearly to *B. lævipes*, which ranges from middle California to Oregon, but it is at once distinguishable on account of its more abundant pubescence throughout and its smaller and fewer-nerved empty glumes. It appears to be related also to *B. Richardsoni* of the Rocky Mountain region, but differs in the much greater pubescence of all of its parts. How long these

several plants can be considered as distinct species seems doubtful, but, for the present at least, it is desirable to maintain them in this rank until we know more about their local variation and distribution; their distribution appears to coincide with well-marked phytogeographic lines.

Distichlis spicata *(L.) Greene*, Bull. Calif. Acad. ii.415.(?) *D. maritima* RAF., of Bot. Calif.

The salt grass so common in parts of Thomas valley is probably to be referred to this species, but it was not collected in flower.

Elymus glaber (*J. G. Smith*) *Davy*, comb. nov. *Sitanion glabrum* J. G. SMITH, U. S. Dept. Agr. Agros. Bull. xviii. 14 (1899). Orchard Barley.

This is an important grass of the drier meadows of Round Valley where it was collected at altitudes of 8300–9000 ft. (Nos. 2501, 2601.)

Elymus glaucus *Buckl.*

This Elymus is very common in the drier meadows and along the streams from 5200 to over 9000 ft. alt. It is exceedingly variable and passes from the typical form, represented by such specimens as nos. 2269 and 2207, through such intermediate forms as nos. 2455 and 2515 directly over into the variety *maximus*. The variation is probably due to the effect of the difference in the light and moisture conditions, since the variety and the forms approaching it were collected only along streams and in deep cañons, while the species is more common on the open and somewhat sandy benches.

Elymus glaucus maximus *Davy*, in Jepson, Fl. Mid. W. Calif. 79 (1901).

Dark Cañon at 6000 ft. alt. (No. 2246.)

The latitudinal range of this variety has been greatly extended by its recent collection in Alaska, according to Mr. E. D. Merrill.

Elymus multisetus *(J. G. Smith) Davy*, comb. nov. *Sitanion multisetum* J. G. SMITH, U. S. Dept. Agr. Agros. Bull. xviii. 11 (1899).

Found only in a sandy meadow of the south side at 4500 ft. alt., this being along the lower edge of the pine belt. (No. 2037.)

Elymus Parishii *Davy & Merrill*, sp. nov.

Stems loosely tufted, 7 to 9 dm. high, scabrid: leaves canescently pubescent with spreading hairs; ligule a mere ring; blades flat or becoming involute, 5 mm. wide, the uppermost 3.5 to 7 cm. long, the lowest 8 to 16 cm. long: spike 10 to 16 cm. long, 10 mm. wide, with somewhat divergent spikelets: spikelets in pairs, the lowest 1 to 2 cm. apart, 1 to 1.5 cm. long excluding the awns, 3 to 5 flowered; empty glumes 11 to 16 mm. long, about 1 mm. wide, awn-pointed; internodes of rachilla 2 to 3 mm. long; flowering glumes scabrous, 10 mm. long; awns 2 to 2.5 cm. long, scabrous.

Type specimen collected in the San Jacinto Mountains, Southern California, on wooded slopes and benches of the south side, at 1460 meters (4800 ft.) alt., June, 1901, (H. M. Hall, no. 2097). Also collected on the west side of the same range at Box Springs, at 1600 meters (5300 ft.) alt., July, 1901, (H. M. Hall, no. 2253); and at Tahquitz Valley, July, 1881, (S. B. & W. F. Parish, no. 1014).

The type is in the Herbarium of the University of California.

The canescently pubescent sheaths and blades, somewhat divergent spikelets and long awns at once distinguish this plant from the other known species of Elymus from this state.

Elymus pubiflorus (*J. G. Smith*) *Davy*, comb. nov. *Sitanion pubiflorum* J. G. SMITH, U. S. Dept. Agr. Agros. Bull. xviii. 19 (1899).

Common in dry soil and on exposed slopes from the lower edge of the pine belt to an altitude of 9300 ft. (Nos. 2065, 2073, 2177, 2409.)

Elymus triticoides *Buckl.* Slender Wild-rye.

Collected in Thomas and Strawberry valleys and also along the eastern base of the mountain. (Nos. 2122, 2177b, 2392.)

Epicampes rigens (*Boland.*) *Benth.* Deer-grass.

The Deer-grass was found growing in dry soil on the West

Fork of Snow Creek at 5000 ft. alt., and in Tahquitz Valley at 6200 ft. alt. (Nos. 2427, 2540.)

Holcus lanatus *L.* Velvet-grass.

Introduced in the meadows of Strawberry Valley, where it was collected by Dr. A. A. Davidson, July, 1896. Also found on Fullers Ridge at 5200 ft. alt.

Kœleria cristata *(L.) Pers.* Crested Kœler-grass.

Occasional along the lower edge of the pine belt of the south and east sides. (Nos. 2066, 2429.)

Kœleria cristata pubescens *Vas.*; *Davy*, in Jepson, Fl. Mid. W. Calif. 61 (1901). Soft Kœller-grass.

On dry, pine-clad hillsides, with the last, but more common, and also running up to 6000 ft. alt. (Nos. 2031a, 2206, 2376).

Melica imperfecta flexuosa *Boland.* Limber Melic-grass.

Collected on Chalk Hill at 4800 ft. alt. and on the North Fork of the San Jacinto River, below the pine belt. (Nos. 2079, 2306.)

Panicularia nervata *(Willd.) Ktze.* Fowl Meadow-grass.

This occurs on all sides of the mountain below the 7000-foot contour, but is nowhere abundant, and is restricted to the wet meadows and stream banks. (Nos. 2244, 2457, 2553.)

Panicum thermale *Boland.*

Collected among the rocks on Chalk Hill at 5000 ft. alt., and also on the North Fork of the San Jacinto River at 3000 ft. alt. (No. 2244.)

Mr. E. D. Merrill, of the United States Department of Agriculture, to whom specimens of our no. 2244 were submitted, has kindly furnished the following note: "I believe all these sheets are referable to *Panicum thermale* Boland., which cannot be confined to the form growing about hot springs on account of intergrading forms with *Panicum unciphyllum* Trin., from which *Panicum thermale* differs in its softer and more dense pubescence."

Phleum alpinum *L.* Alpine Timothy.

Abundant in the wet meadows of Tahquitz Valley at 7500-8500 ft. alt. (No. 2351.)

Poa alpina *(L.)* Mountain Spear-grass.

Common in the Carex meadows of Round Valley, altitude 9000 ft. (No. 2482.)

Poa Buckleyana *Nash*, Bull. Torr. Club xxii. 465 (1895). Bunch Red-top.

Beneath pines of the south and west sides at 5000-6000 ft. alt. (Nos. 2064, 2257.)

Poa Howellii Chandleri *Davy*, var. nov. Chandler's Meadow-grass.

Stems 3.5 to 5.5 dm. high: leaves smooth; sheaths somewhat inflated; ligule scarious, white, truncate, dentate, 2 to 4 mm. long; blades flat, acute, 3 to 5 cm. long, 5 mm. wide: panicle but little exserted (at least in young plants), 7 to 13 cm. long; branches sparsely scabrid, remote, the lowest in whorls of 3 to 5, the whorls 2.5 to 3.5 cm. apart; lowest branches very unequal, 1.5 to 7 cm. long, spikelet-bearing only on the upper half: spikelets 4.5 to 5 mm. long, 2-flowered; empty glumes minutely puberulent and serrate, broad, the lower 2 mm. long, acute, 1-nerved, upper about 3 mm. long, emarginate, 3-nerved; rachilla smooth, internodes 1.5 mm. long; flowering glumes scabrid, 3 mm. long, acute, sparingly webbed at base with a long thin web; stamens 3, anthers 1.5 mm. long.

Type specimen collected in Shackleford Cañon, near Marble Mt., Siskiyou Co., about 1800 meters (6000 ft.) alt., June, 1901, (Harley P. Chandler, no. 1703). Since collected in the San Jacinto Mts., Southern California, in damp places in the vicinity of Deer Springs, at 2760 meters (9000 ft.) alt., July, 1901 (H. M. Hall, no. 2573.5), and in Round Valley at 2800 meters (9200 ft.) alt. (H. M. Hall, no. 2594).

The type is in the Herbarium of the University of California.

This plant closely resembles the species in aspect, but differs in the smaller panicle, longer but fewer-flowered spikelets, and the lack of prominent pubescence.

Polypogon Monspeliensis *(L.) Desf.* Beard Grass.

This grass has been introduced into Strawberry and Thomas valleys. (No. 2274.)

Sporobolus depauperatus (*Torr.*) *Scribn.*, Bull. Torr. Club. ix. 103 (1882). *Vilfa depauperata* Torr., of Bot. Calif.

Common and well distributed between the 5000 and 9200-foot contours. (Nos. 2341, 2428, 2477, 2545.)

Sporobolus gracillimus (Thurb.) *Scribn.*, Bull. Torr. Club ix. 103 (1882). *Vilfa gracillima* THURB., of Bot. Calif.

This species requires a moister soil than does the last and it is probably for this reason that it is less common on the mountain, the only collections being made in damp meadows and around springs in Strawberry and Tahquitz valleys. (Nos. 2290, 2359.)

Stipa Californica *Merrill & Davy*, sp. nov.

A rather stout erect cæspitose glabrous perennial, 7 to 10 dm. high, with plane or involute leaves and elongated contracted panicles about 3 dm. in length: culms and nodes glabrous; sheaths shorter than the internodes, glabrous except on the somewhat ciliate margins above; ligule a minute lacerate ring 0.5 mm. long, with a prominent fringe of hairs on the apparently auriculate margins, 1.5 mm. long; blades firm, plane or becoming involute in drying, 2 to 4 mm. wide, 1 to 1.5 dm. long, glabrous beneath, striate and scabrous above: panicles pale, interrupted, the common axis glabrous, branches solitary or in twos or threes at each node, appressed, flower-bearing throughout, the lower ones sometimes 1 dm. long: empty glumes glabrous, hyaline, 3-nerved, about 11 mm. long, sub-equal, with a very slender acuminate apex; flowering glumes about 5 mm. long, excluding the very acute pilose callus which is 1 mm. long, lanceolate, sparingly hairy throughout with appressed stiff white hairs which increase in length toward the apex of the glume: awn slender, 2.5 to 3 cm. long, geniculate, twisted and sparingly pilose below the geniculation with appressed or ascending hairs, scabrous above.

Type specimen collected by H. M. Hall, no. 2556, north side Fullers Ridge, San Jacinto Mountains, Southern California, July, 1901, 2100 meters (7000 ft.) alt.

Other Californian specimens examined:

Soda Springs, Sierra Nevada, Aug. 7, 1901 (P. B. Kennedy

and S. B. Doten, 247). Wawona, Mariposa Co., June 3, 1897 (J. W. Congdon). No locality (H. N. Bolander) distributed as *Stipa viridula* Trin. (Three sheets.)

The type is in the U. S. National Herbarium and a co-type in the Herbarium of the University of California.

This species is most closely related to *Stipa Scribneri* Vasey, being distinguished by its more interrupted panicles and much longer awns which are pilose below, and in the fewer and shorter hairs at the apex of the flowering glume.

Stipa Elmeri *Piper & Brodie*, in U. S. Dept. Agr. Agros. Bull. xi. 46 (1898).

Collected only on the north side of the mountain at about 5000 ft. alt. (No. 2537.)

Stipa occidentalis montana *Merrill & Davy*, var. nov. *Stipa occidentalis* THURBER, U. S. Geol. Expl. 40th Par. v. 380 (1871), in part.

A slender densely tufted form, 2 to 5 dm. high with strict few-flowered panicles and prominent twice-geniculate awns, 3 to 3.5 cm. long which are ciliate throughout with spreading or ascending white hairs about 1 mm. long.

Specimens examined all from California:

Yosemite Trail, on loose, disintegrated granite, Aug. 20, 1866 (Dr. H. N. Bolander, no. 5038, type); same locality (Bolander, no 29). Summit of Tahquitz Peak, San Jacinto Mountains, June, July, 1901 (H. M. Hall, no. 2325); rocky ridges and peaks, 2700 meters (8800 ft.) alt. Soda Springs, Sierra Nevada, 1881 (M. E. Jones, no. 283). Bear Valley, no date (Dr. H. N. Bolander). Long Meadow, Tulare County, July 7–14, 1888 (Dr. Ed. Palmer, no. 232). "In dry, sandy soil near Ostranda's. * * * Quite common. Yosemite Trail, 8000 ft.," 1866 (Bolander, no. 5920).

The type is in the U. S. National Herbarium, and co-type in the Herbarium of the University of California.

This variety is at once distinguished from the species by the awn being pilose throughout, while in the species it is pilose below, but only scabrous above the second geniculation. No. 5038 *Bolander* is the first specimen cited in the original description of *Stipa occidentalis*, but the description calls for a plant

with awn scabrous above, which specification is supplied by the second specimen cited, no. 1296 *S. Watson*, Pah Ute Mountains, Nevada, June, 1868, and which under these circumstances we consider to be the type of the species. For a discussion of *Stipa occidentalis* Thurb., see Piper, U. S. Dept. Agr. Div. Agros. Cir. xxvii. 10 (1900).

"Sheep-men say this grass is much liked by sheep, and that they fatten more on this than any other." (Bolander's field notes, 1866.)

Stipa Parishii *Vas.*, Bot. Gaz. viii 32 (1882). Parish's Feather-grass.

This grass was found among the rocks at Kenworthy, and also at 7000 ft. alt. on Tahquitz Ridge. (No. 2309.)

Stipa Vaseyi *Scribn.*, U. S. Dept. Agr. Agros. Bull. xi. 46 (1898). Sleepy Grass.

Collected in open places on Chalk Hill at 4800 ft. alt. (No. 2078.)

Trisetum nutkænse *(Presl.) Scribn. & Merrill*, comb. nov. *Avena nutkænsis* PRESL. Rel. Haenke i. 254 (1830). *Trisetum cernuum* TRIN., Mem. Acad. St. Peters. vi. Sci. Math. Phys. et Nat. i. 61 (1831). *Avena cernua* KUNTH, Enum. i. 306 (1833).

The type locality is of Presl's *Avena nutkænsis*, viz., "Hab. in sinu Nootka." His very full description applies exactly to *Trisetum cernuum* Trin., which was published one year later. (Merrill, MS.)

This grass was collected on Strawberry Creek at 5300 ft. alt. (No. 2514.)

Trisetum subspicatum *Beauv.*

This is the only grass which grows on San Jacinto Peak, where it was collected by Dr. A. A. Davidson, July 11, 1896.

CYPERACEÆ.

Carex festiva *Dewey.*

Collected at 9000 ft. alt. on the shores of Lake Surprise, and also near Fuller's mill. (Nos. 2250, 2492.)

For the determination of this and the following species of Carex the author is indebted to Professor C. F. Wheeler, of the Michigan Agricultural College.

Carex feta *Bailey*, Bull. Torr. Club xx. 417 (1893).

This species was collected in Tahquitz Valley, alt. 7000 ft., in Strawberry Valley, alt. 5300 ft., and at Fuller's mill, alt. 5800 ft. At the last mentioned station it forms a small meadow. (Nos. 2459, 2561, 2665.)

Carex Hallii *Bailey*, Proc. Am. Acad. xxii. 82 (1886).

This is the dominant plant in the wet Carex meadow of Round Valley, 9000 ft. alt., and was also found at Deer Springs, the altitude of which is about the same. It is readily eaten by stock, but *Poa alpina* and *Trifolium monanthum*, which grow in the same meadow, are much preferred. (Nos. 2338, 2483.)

Carex marcida *Boott.*

West end Fullers Ridge, altitude 5200 ft. (No. 2664.)

Carex Nebraskensis *Dewey.*

Collected in Round Valley with the last, from which it is readily distinguished in the field by its ashy-gray color. It is not so abundant as *C. Hallii*, being restricted to the half-boggy portions of the meadow, but is likewise eaten by stock. (No. 2484.)

Carex nudata *W. Boott.*

Along Tahquitz Creek at 7000 ft. alt. (No. 2461.)

Carex Preslii *Steud.*, Pl. Cyp. 242 (1885).

Collected only on San Jacinto Peak, where it is quite common among the summit rocks. (No. 2416.)

Cyperus aristatus *Rottb.*

Collected along Strawberry Creek. (No. 2663.)

Eleocharis acicularis *R. Br.* Needle Spike-rush.

On moist stream banks in Onstatt and Tahquitz Valleys and on the shores of Lake Surprise. (Nos. 2232, 2366, 2495.)

Eleocharis palustris *R. Br.* Creeping Spike-rush.

This grows abundantly in the shallow water of Lake Surprise. (No. 2489.)

Scirpus microcarpus *Presl.*

Around springy places; Strawberry Valley. (No. 2289.)

JUNCACEÆ.

Juncus bufonius *L.* Toad Rush.

Very common in moist soil below the 6000-foot contour. (No. 2076.)

Juncus effusus *L.* Bog Rush.

In streams near Strawberry Valley. (No. 2390.)

Juncus macrophyllus *Coville*, nom. nov. *Juncus canaliculatus* Engelm., Bot. Gaz. vii. 6 (1882), not Liebmann (1850).

Dr. Engelmann considered this species, when he described it, most nearly related to *Juncus marginatus* Rostk., but its closest ally is undoubtedly *J. longistylis* Torr. The red color of the anthers, which was given as a specific character in the first description, and which was the basis of the affinity originally assigned it with *marginatus*, is not constant, even in the type specimen, a portion of which, through the kindness of Mr. S. B. Parish, I examined several years ago. In open flowers of specimens collected by Dr. H. E. Hasse near Los Angeles, California, the anthers are of the pale yellow color usual in the genus, while in a mature fruiting specimen collected by him they vary from a reddish to a blackish brown. Under suspicion of being diseased, some of these red anthers were examined at my request, in 1893, by Mr. D. G. Fairchild, who reported that a *Cladosporium* was present in abundance and that the reddening of the tissues was undoubtedly caused by this saprophytic fungus.

Juncus macrophyllus may be contrasted with *Juncus longistylis* by the following characters: rootstock 1.5 to 3 mm. in diameter, stouter and shorter than in *J. longistylis;* stem stouter than in

that species; basal leaves from one-half the height of the stem to fully as high, sometimes reaching a length of 60 cm.; inflorescence 10 to 25 cm. high, or sometimes in depauperate specimens less, bearing usually 8 to 30 3 to 12-flowered heads; perianth never castaneous, the inner parts longer than the outer; capsule about three-fourths as long as the perianth, stramineous, narrowly oblong, rather abruptly tapering into a short stout beak. No mature seeds have been seen. In *longistylis* the basal leaves are rarely half as long as the stem; the inflorescence has fewer heads; the perianth parts are commonly of equal length and with castaneous lateral stripes; and the capsule is usually dark brown, equaling or nearly equaling the perianth, and with a broad truncate or retuse apex and slender mucro.

Juncus macrophyllus has been collected at various points in Los Angeles, San Diego, and San Bernardino counties, California, and in Lower California, by Parish, Hasse, Orcutt, and others, and at Hot Springs, Maricopa County, Arizona, by J. W. Toumey.

The above note has been kindly furnished by Mr. Frederick V. Coville, of the United States National Herbarium.

Juncus macrophyllus was collected on the west fork of Snow Creek at 5500 ft. alt. and on Strawberry Creek at 5300 ft. alt. (Nos. 2522, 2536.)

Juncus Mexicanus *Willd.* Wire-grass. *J. compressus* HBK., of Bot. Calif.

This is the dominant species of the Wire-grass meadows of altitudes less than 6000 ft. In Thomas and Onstatt valleys it forms meadows which cover a total area of over 1600 acres, and supplies feed for thousands of head of cattle. (No. 2031.)

Juncus oxymeris *Engelm.*

Strawberry Valley, 5400 ft. alt. (No. 837.)

Juncus phæocephalus paniculatus *Engelm.*

Collected at various places on the north and west sides at 5500–8500 ft. alt. (Nos. 2248, 2543.)

Luzula comosa *Meyer. Juncoides comosum* SHELDON. Common Wood-rush.

Along streams in Tahquitz Valley, Round Valley, and probably elsewhere. (Nos. 2460, 2606a.)

LILIACEÆ.

Allium hæmatochiton *Wats.* Wild Onion.

Along streams of the south side at about 5000 ft. alt. The bulbs and stems are often in pairs and the involucre is composed of three bracts instead of two as usually described. (No. 2096.)

Allium Parryi *Wats.* (?)

A small onion which probably belongs to this species was collected among the rocks of Tahquitz Ridge at 6500 ft. alt., but in too poor a condition to be definitely determined. (No. 2310.)

Bloomeria aurea *Kell.* Golden Bloomeria.

Quite common in open pine forests on the south and west sides of the mountain up to an altitude of 6000 ft. (No. 2101.)

Brodiæa capitata *Benth.* *Hookera capitata* KTZE., Rev. Gen. Pl. 712 (1891). Blue Dicks.

Occasional throughout the Lower Transition Zone but more frequent at lower altitudes.

Brodiæa minor *(Benth.) Wats.* *Hookera minor* BRITTEN, Journ. Bot. xxiv.

Found only in meadows near Strawberry Valley. (No. 2093.)

Calochortus invenustus *Greene*, Pitt. ii. 71 (1890).

Very common, usually in meadows but also on shaded hills throughout the Transition and Canadian zones, reaching an altitude of 9400 ft. near Round Valley. This is probably a mere variety of *C. splendens*, since it exhibits all degrees of gradation from the robust form with well developed bulblets and umbellate inflorescence to the slender-stemmed form described by Purdy,* from specimens collected in Strawberry Valley, as *C. splendens* var. *montanus*. In fully opened flowers the sepals are always shorter than the petals and the color is much paler than in flowers of *C. splendens*. (Nos. 2297, 2475.)

Calochortus concolor *(Baker) Purdy*, Proc. Calif. Acad. ser. 3 (bot.) ii. 135 (1901). *C. lutens concolor* BAKER, Garden xlviii.103 (t.) (1895). Maldeojo.

* Proc. Calif. Acad. ser. 3, (bot.) ii. 143 (1901).

This handsome lily of the Mariposa group, so common in the chaparral belt bordering on the desert, does not enter the pine forests but reaches an altitude of 5300 ft. on Chalk Hill, which is surrounded by groves of Yellow Pine. The Indians assert that the juice of the bulb is bad for the eyes, hence the common name as given above. (No. 2285.)

Muilla serotina *Greene*. Muilla.

This plant grows in the meadows of Thomas Valley, the greenish-white blossoms appearing late in May. (No. 1138.)

Nolina Parryi *Wats.*

The Nolina barely enters our limits, being found at Kenworthy in blossom in May and beneath the last pines along the edge of the chaparral belt in lower Tahquitz Valley in fruit in the latter part of July. (Nos. 1819, 2423.)

Lilium Parryi *Wats.* Parry Lily.

This lily, with its tall, erect stems and conspicuous flowers either clear yellow or peppered with black, is a great favorite with the tourists and campers that annually visit the mountain. It was only a few years ago that the showy blossoms were very frequently met with along all the streams and bogs from nearly the lower edge of the Transition Zone up to an altitude of 9000 ft., thus reaching into the lower part of the Canadian Zone. While it is now by no means rare, still it is found in profusion only on the more remote parts of the mountain. That this is due entirely to the diligence of the bulb hunters is difficult to believe, and yet one party took out over 5000 bulbs in a single season. Perhaps this, in addition to several consecutive dry summers, is responsible for the rapid depletion in their numbers.

At the lower altitudes the first blossoms appear about June 20, and by the first of July they may be expected along any of the streams.

The anthers of the Parry Lily appear to be erect and basifixed at first and later to become versatile. This change is brought about as follows: The filament is attached to one side and near the middle of the anther, but the latter, instead of swinging free, is held to the filament by the two anther cells

which, swollen with pollen, press firmly against its upper part, holding it as in a vise. As the pollen is shed these cells collapse and the anther is then free to take up a horizontal position on the tip of the filament. (Nos. 695, 798, 963, 2451.)

Smilacina amplexicaulis *Nutt.* False Solomon's Seal.

Found only in the upper part of Onstatt Valley and near Deer Springs. (No. 2572.)

Veratrum speciosum *Rydb.*, Bull. Torr. Club xxvii. 532 and 650 (1901). *V. Californicum* of Bot. Calif., not of Durand. False Hellebore.

This species borders the streams of the higher valleys, reaching 9200 ft. alt. in Round Valley, but does not occur on the west side. (Nos. 781, 2468.)

Yucca Whipplei *Torr.* *Hesperoyucca Whipplei* BAKER. Yucca. Spanish Bayonet.

The Yucca is found growing on the chaparral-covered slopes of Chalk Hill and is common over the foot-hills of the south and west sides.

IRIDACEÆ.

[IRIS HARTWEGI AUSTRALIS *Parish*, Erythea vi. 87 (1898).

This has been reported from San Jacinto,* but erroneously, since no species of Iris has yet been collected on the mountain.]

Sisyrinchium bellum *Wats.* Blue-eyed-grass.

Not rare throughout the Transition Zone, growing along streams and in meadows. (Nos. 2247, 2340, 2470.)

ORCHIDACEÆ.

Corallorhiza multiflora *Nutt.* Coral-root.

Found only in upper Strawberry Valley and in Tahquitz Valley but to be expected anywhere in the Yellow Pine and Fir forests. (Nos. 2345, 2523.)

* Erythea vi. 87 (1898).

Epipactis gigantea *Dougl.* Stream Orchis.

This orchis was collected along streams of the south side between 4200 and 6000 ft. alt. It is plentiful in Lily Cañon. (Nos. 668, 2370.)

Habenaria leucostachys *Wats.* Sierra Rein-orchis.

Much more general in its distribution than the last, being found along streams on all sides of the mountain and up to 9000 ft. alt. (Nos. 729, 961, 2448, 2513.)

Listera convallarioides *(Sw.) Torr.* Broad-lipped Twayblade.

The range of this species was considerably extended by its discovery in cool, shaded cañons on the north side of San Jacinto Mountain at about 7500 ft. alt. (No. 2534.)

SALICACEÆ.

Populus trichocarpa *T. & G.* Black Cottonwood.

Seen only along Tahquitz Creek at 6000 ft. alt., where there is a small grove. The trees average only 30 ft. in height. (No. 2445.)

Salix cordata Mackenzieana *Hook.*

Collected only on Tahquitz Creek in the lower part of the pine belt. (No. 2447.)

Mr. Parish has kindly sent us a specimen of a willow collected by himself in the San Bernardino Mts., (no. 1785), which was determined by Mr. Bebb as *S. cordata Watsoni* Bebb, and which is exactly the same as our no. 2447 except that the aments are slightly shorter. But both of these seem to be nearer the var. *Mackenzieana*, into which the var. *Watsoni* should probably be merged. The San Jacinto Mt. specimens are 10 ft. high; the leaves 1½–2½ in. long, 7–9 lines wide at the middle and in outline the same as those figured by Sargent* (not oblong and short-acuminate as given for var. *Watsoni*); pistillate aments 15 lines long; capsules on stalks 1 line long.

* Silva ix. t. 479 (1896).

Salix lævigata *Bebb.* Willow.

A common willow of the south and west sides in the Transition Zone and below but confined to the water courses. (Nos. 2278, 2510.)

Salix lasiolepis *Benth.* Arroyo Willow.

Common both along streams and on hillsides on all parts of the mountain up to 9200 ft. alt. The willows are not of much service as zone indicators on account of their great vertical range. The present species ranges from the Upper Sonoran Zone to the Canadian. (Nos. 2350, 2511.)

BETULACEÆ.

Alnus rhombifolia *Nutt.* White Alder.

Fringes all the lower streams of the west and south sides, reaching an altitude of 6500 ft. in Onstatt and Strawberry valleys. (No. 2521.)

FAGACEÆ.

Castanea sempervirens *Kell.*, Proc. Calif. Acad. i. 75 (1855, reprint). *Castanopsis chrysophylla*, of Bot. Calif., in part, not of A. De Candolle. *Castanopsis sempervirens* Dudley, in Merriam, N. A. Fauna xvi. 142 (1899). Sierra Chinquapin.

The Chinquapin is the most important shrub of the chaparral formation of the boreal region, but is also found in the Upper Transition Zone. Its altitudinal range is from 8000 ft. to the very summit of the mountain (10,805 ft.). (Nos. 724, 2466.)

Quercus Californica *Cooper.* *Q. Kelloggii* Newb. Black Oak. Kellogg Oak.

Very common in the Transition Zone of the south and west sides, rare in Tahquitz Valley, not seen on the north side; it is thus seen that the Kellogg Oak avoids the desert side of the mountain.

Quercus chrysolepis *Liebm.* Live Oak.

This tree is not rare all around the mountain up to 6000 ft.

alt. At the head of Strawberry Valley it is reduced to a mere shrub, and at 7000 ft. alt. on Tahquitz Ridge occurs a form only a few feet high. This dwarf form is not to be confused with the var. *vaccinifolia* Engelm.* (Nos. 2524, 2466.)

Quercus dumosa *Nutt.* Scrub Oak.

Abundant in the chaparral belt, and often found beneath the pines at considerable altitudes on the south side. (No. 2644.)

URTICACEÆ.

Urtica holosericea *Nutt.* Nettle.

Collected at various places below the 6000-foot contour.

LORANTHACEÆ.

Arceuthobium occidentale *Engelm.* Pine Mistletoe.

Quite common on *Pinus ponderosa* and its var. *Jeffreyi*, on *P. Coulteri* and on *P. Lambertiana*. (Nos. 2100, 2566.)

Phoradendron juniperinum Libocedri *Engelm.*

Not rare on *Libocedrus decurrens*. (No. 2565.)

Phoradendron villosum *Nutt.* Mistletoe.

Abundant on the two common oaks,—*Quercus Californica* and *Q. chrysolepis*. (No. 2531.)

POLYGONACEÆ.

Chorizanthe fimbriata *Nutt.*

Found at 5300 ft. alt. on the west side. (No. 2255.)

Chorizanthe staticoides *Benth.*

Very common in the lower foot-hills and reaching into the pine forests on the Johnston Ranch.

Eriogonum apiculatum *Wats.*, Proc. Am. Acad. xvii. 379 (1882).

*Cf. Merriam, in N. A. Fauna xvi. 142 (1899).

Considerable time was spent in tracing the limits of the range of this local species, the type locality of which is Strawberry Valley. It was found to be quite plentiful on gravelly benches in the open pine forests of the south and west sides from the lower edge of the pine belt to 8200 ft. alt., where it was collected on Mistake Creek and near Tahquitz Peak. It is most common on Fullers Ridge from which it reaches to Snow Creek. It occurs only sparingly in Tahquitz Valley but extends down into the upper part of the chaparral belt of the east side, where it is more plentiful. A robust form was collected in 1898 by Dr. C. A. Purpus on Cuyamaca Mt., the only known station outside of the San Jacinto Mts. Its zonal position is Transition, rarely running over the lower border. (Nos. 849, 2364, 2431, 2564.)

The specimens vary from a few inches to 2 ft. or more in height. The following field notes were taken on no. 2431, from the upper part of the chaparral belt of the east side: Obtuse lobes of the involucre equalling the tube, fully equalled by the stipe; outer perianth segments merely obtuse and long-apiculate, inner segments with a truncate tip which is horned from the sides and apiculate from the emarginate center; the red anthers pendulous when young, not exserted.

Eriogonum Baileyi *Wats.*

Collected on Chalk Hill and near Fuller's mill. (No. 2988.)

Eriogonum fasciculatum *Benth.* Wild Buckwheat.

Very common throughout the Upper Sonoran Zone and occasionally found beneath the pines. (No. 764.)

Eriogonum gracile *Benth.*

On the south side with the next. (Nos. 860, 2624.)

Eriogonum molestum *Wats.*, Proc. Am. Acad. xvii, 379 (1882).

Common on the south and west sides at 5000–6000 ft. alt. In sandy, open places around Strawberry Valley are found large Eriogonum beds composed of this species intermixed with *E. gracile*, from which it may be distinguished by its taller, always glabrous branches, its leaves which are more obtuse at base, its long internodes (an inch or more), and larger involucres and flowers. (Nos. 2386, 2624a.)

Eriogonum nudum pauciflorum *Wats.* Naked-stem Eriogonum.

Common throughout the Transition Zone. Robust, involucres 3 lines high and many-flowered but always solitary or in pairs. (No. 2504.)

Eriogonum saxatile *Wats.*

This is one of the characteristic xerophytes that inhabit the exposed, gravelly ridges running out from Tahquitz Peak. Not found elsewhere. Its long, tough roots and densely tomentose leaves and stem eminently fit it for the conditions under which it exists. (Nos. 729, 2324.)

Eriogonum stellatum *Benth.*

Well distributed throughout the Transition Zone, blossoming in August.

Eriogonum Wrightii subscaposum *Wats.*

Collected at Lake Surprise, Tahquitz Valley, and a few other places above 7500 ft. alt. (No. 816.)

Eriogonum Wrightii taxifolium *(Greene) Parish*, Erythea vi. 87 (1898). *E. taxifolium* GREENE, Pitt. i. 267 (1889) and ii. 295 (1892).

Common throughout the Lower Transition Zone, mostly below 7000 ft. alt., flowering in Aug. and Sept. (No. 2608.)

Oxyria digyna (*L*) *Camptd.* Alpine Sorrel.

This plant was not known to occur in Southern California until it was discovered by Mr. S. L. Wight in Aug., 1897, on San Jacinto Peak, where, more than any other species, it indicates the presence of the Alpine Zone. It grows all along the banks of perpetual snow, which lie just below the main peak on the north side and therefore at the head of Snow Creek Cañon. It will be surprising if it is not sometime found on the cold north side of Grayback Mt., which lies to the north of San Jacinto, and is separated from it by a deep but narrow pass. (Nos. 794, 2415.)

Oxytheca caryophylloides Parry.

Collected at Fuller's mill.

Oxytheca emarginata *Hall*, sp. nov. PLATE XIV.

Slender annual, 2–6 in. high, more or less glandular-pubescent up to the involucres, the leaves and bracts sparsely strigose-pubescent, the whole herbage and especially the involucres early turning red: leaves clustered near base of stem, narrow, oblanceolate, emarginate, 4–8 lines long: bracts ternate, or the lower rarely 4 or 5 in a whorl, ovate, awned, united at base except on one side of the stem: peduncles 1–4 lines long; involucres obpyramidal, 3 lines high, shallowly 5-lobed, each lobe with a narrow white membranous margin and tipped with an awn a line or less in length: flowers usually 4, on short pedicels, slightly exserted, externally pubescent on the lower half: segments 6, distinct to the base, oblanceolate, fimbriate above into slender divisions, 1¾ lines long: stamens 9: akene triangular, enclosed by the withering-persistent perianth.

Collected on a gravelly ridge near Tahquitz Peak, San Jacinto Mts., California, at about 7200 ft. alt., July 2, 1901 (H. M. Hall, no. 2331.) The type is in the Herbarium of the University of California.

The organ which immediately engages our attention on examing this species is the conspicuous red involucre, which is formed by the coalescence of the five bracts into a concave disk, thus simulating the disk produced by the union of the bracts around the stem in *O. perfoliata*. That the disk in the proposed species does not correspond to that in *O. perfoliata* is made clear, however, when we consider that in the latter it encloses an inner involucre, which itself surrounds a number of flowers, while within the disk of *O. emarginata* we find nothing but flowers, each borne on a short pedicel. Moreover, the disk of *O. perfoliata* is made up of but 3 united bracts, as against 5 in *O. emarginata*, and the stem in the former is continued through the disk, branching and flowering above it, while in the latter the disk is terminal.

The new species is in reality much nearer to *O. trilobata*, although the similarity is at first not apparent. In both species the ternate bracts are united at base and surround the stem except on the one side; while from the axes of these bracts arise pedicels several lines long, each of which bears at its end an involucre enclosing a number of flowers. In *O. trilobata* this

ultimate involucre is composed of small, narrow bracts united only at the base, while in *O. emarginata* they are united into a conspicuous, concave disk.

EXPLANATION OF PLATE XIV. *Oxytheca emarginata.*—Fig. 1. Plant; natural size. Fig. 2. Perianth,—spread out; enlarged eight diameters. Fig. 3. Involucre, front folded down, exposing two open flowers and two others with withering corollas; enlarged two diameters. Fig. 4. Pistil; enlarged eight diameters.

Oxytheca trilobata *Gray.*

Not rare in dry soil of the upper part of the chaparral belt. (Nos. 975, 2082.)

Polygonum aviculare *L.* Yard Grass.

An introduced weed in Strawberry Valley.

Polygonum bistortoides *Pursh.* *P. Bistorta* L., of Bot. Calif. etc.

Abundant in bogs and wet meadows of the Canadian Zone as well as of the colder parts of the Transition. (Nos. 726, 2358.)

Polygonum Douglasii *Greene,* Bull. Calif. Acad. 1. 125 (1885). *P. tenue* MICHX., of Bot. Calif.

Of the same range as the last but in comparatively dry soil and not so common. (No. 2446.)

Polygonum Watsoni *Small,* Monogr. N. A. Polyg. 138 (1895). *P. imbricatum* NUTT., of Bot. Calif.

Collected along a stream in Tahquitz Valley at 8000 ft. alt. (No. 2354.)

Pterostegia drymarioides *F. & M.*

Chalk Hill, among rocks. (No. 2080.)

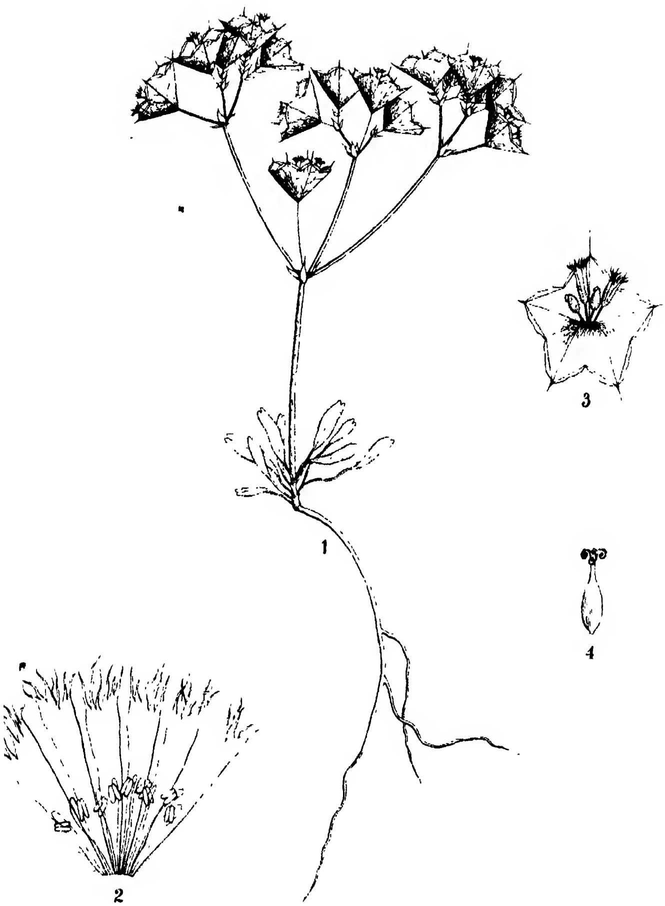
Rumex salicifolius *Weinm.* Willow-leaved Dock.

In the Transition Zone, reaching 9000 ft. alt. (Nos. 2474, 2525.)

CHENOPODIACEÆ.

Chenopodium album *L.* Pigweed. White Goosefoot.

Collected at various places below 9000 ft. alt. (Nos. 2178, 2473.)



OXYTHECA EMARGINATA

AMARANTACEÆ.

Amarantus albus *L.* Tumble Weed.

In cultivated fields of Strawberry Valley, etc.

NYCTAGINACEÆ.

Abronia villosa *Wats.* Pink Sand-verbena.

Common beneath the pines in Thomas Valley, which it enters from the desert region. Here the flowers are large for this species; tube 7–11 lines long, lobes 2–3 lines long. (No. 1109.)

PORTULACACEÆ.

Calyptridium monandrum *Nutt.*

Beneath chaparral on the south and west sides, scarcely reaching the pine belt. Sepals 2; petals 3, white, nearly orbicular, apiculate, equal, one upper and two lateral thus leaving an opening on the lower side; stamen 1, the yellow anther prominent in the opening between the lateral petals; capsule compressed, much exserted and conspicuous on old stems. (Nos. 1133, 2050.)

Montia Chamissonis (*Esch.*) *Greene*, Fl. Fr. 180 (1891). *Claytonia Chamissonis* ESCH.

Plentiful along the stream which flows through the Carex meadow of Round Valley, at 9000 ft. alt. This is probably the southern limit of its range. (No. 2402.)

Montia perfoliata (*Don.*) *Howell*, Eryth. i. 38 (1893). *Claytonia perfoliata* DON. Indian Lettuce.

Moist places, to 6000 ft. alt.

Montia spathulata (*Dougl.*) *Howell*, l. c. *Claytonia perfoliata spathulata* TORR, of Bot. Calif.

Often with the last but not so common. (No. 2218.)

Spraguea umbellata *Torr.* Pussy-paws.

Common from the upper part of the Transition Zone to the summit. The specimens from the summit approach var. *caudicifera* Gray, while those from lower altitudes might pass for *S. paniculata* Kell., since in many cases one or more of the cyme-branches are scattered along the stem. (Nos. 714, 2352.)

CARYOPHYLLACEÆ.

Arenaria Douglasii *Fenzl.* Sandwort.

Abundant in spring on the south and west sides, below 5300 ft. alt. (No. 1813.)

Silene laciniata *Cav.* Indian Pink.

Same range as the last, usually beneath chaparral. (Nos. 312, 2019, 2303.)

Silene Parishii *Wats.*, Proc. Am. Acad. xvii. 366 (1882); Robinson, Syn. Fl. i. pt. 1, 218 (1897).

Common on all the rocky and gravelly ridges above 8000 ft. alt. and also found on Santa Rosa Peak. Always limited to the Canadian and Hudsonian Zones. (Nos. 312, 313, 791, 2314, 2549.)

My field notes on this species, the range of which is restricted to the San Jacinto and San Bernardino Mts., read as follows: Viscid pubescent and strongly scented, calyx greenish yellow; corolla yellow, pubescent, petals attenuate at base, deeply 2-cleft, the lobes variously laciniate, toothed or fimbriate and therefore appearing to be many-cleft, face of each of the two primary lobes with an erose scale at base, petal with long lateral teeth opposite the scales; styles 3.

Silene verecunda *Wats.*

Everywhere beneath pines in open forests at 5000–9000 ft. alt. (Nos. 2383, 2550, 2591.)

In Round Valley, near the upper limit of its range, was found growing with the ordinary form another with deep purple petals and anthers, the latter being so dark that they were plainly noticeable to one riding by on horseback. In this form

each petal usually bears a pair of short, lacerate scales and has margins either entire or toothed, but some petals are destitute of appendages and entire except for the bifid tip. (No. 2590.)

Stellaria crispa *C. & S.*

Collected only in a meadow of Round Valley at 9000 ft. alt., in the Canadian Zone. Not before known from south of the Sierras of Fresno Co. (No. 2481.)

RANUNCULACEÆ.

Aquilegia truncata *F. & M.* Columbine.

Typical specimens of this species are common along streams on all sides of the mountain up to 8800 ft. alt. They attain a height of 3–4 ft.; leaves averaging 10 in. long, beyond the petiole, which measures 16 in. more, the ultimate segments 2¼ in. long. (No. 2374.) Just north of the main peak, growing along banks of perpetual snow, occurs an alpine form quite different in general appearance. It is only 12 in. high from a strong woody root; leaves under 2¼ in. in length, on petioles over twice as long, the ultimate segments 7 lines long; flowers somewhat smaller than those of the ordinary form, but much larger in proportion to the size of the plant. (No. 2417.)

Clematis ligusticifolia *Nutt.* Virgin's Bower.

Near water-courses, Strawberry Valley. (No. 2528.)

Delphinium decorum patens *(Benth.) Gray.* Larkspur.

Beneath pines of the south side, at higher altitudes than the next. (No. 1804.)

Delphinium Parryi *Gray.*

Common in the foot-hills and as far up as Chalk Hill. (No. 2287.)

Ranunculus alismæfolius alismellus *Gray.* Buttercup.

Found only in the wet meadows of Round Valley at 9000 ft. alt. This station is in the Canadian Zone. The first collection of this species made in Southern California was by Dr. Hasse,* who obtained it in Tahquitz Valley. (No. 2405.)

*Acc. to Parish, Zoe iv. 161 (1893).

Ranunculus Californicus latilobus *Gray.* *R. Ludovicianus* GREENE, Bull. Calif. Acad. ii. 58 (1886) and Fl. Fr. 300 (1892).

In meadows on the Johnston Ranch at 4800 ft. alt.

Ranunculus Cymbalaria *Pursh.*

Along borders of a pond at 4500 ft. alt. in the Thomas Valley. (No. 2169.)

Ranunculus Eschscholtzii *Schlecht.*

This alpine species is plentiful along snow banks on the north side of the main peak, where it grows with *Oxyria digyna.* (Nos. 790, 2414.)

Thalictrum Fendleri platycarpum *Trelease*, Proc. Bost. Soc. Nat. Hist. xxiii. 304 (1886).

Not rare at 6000–9000 ft. alt., in the neighborhood of streams. Leaves glabrous, as seen under the hand lens, but under the compound microscope the lower surface is seen to be roughened by the convexity of the epidermal cells as described by Coville.* Inflorescence, with the exception of the sepals and bracts, glabrous. (No. 2497.)

Thalictrum polycarpum *Wats.* Meadow Rue.

Found in Strawberry Valley at the lower limits of the last. More common in the cañons of the foot-hills. (No. 644.)

LAURACEÆ.

Umbellularia Californica (*H. & A.*) *Nutt.* California Laurel. Bay Tree.

The California Laurel, which assumes the dimensions of a fair-sized tree in northern California, grows to a height of only about 15 ft. on San Jacinto Mt., which is probably near its southern limit, and where it is confined to the cañons of the west side below 5000 ft. alt. It is not rare there and belongs to the Upper Sonoran Zone.

* Contr. U. S. Nat. Herb. iv. 55 (1893).

PAPAVERACEÆ.

Argemone platyceras *Link & Otto.* Prickly Poppy.

Extending into the pine belt near Kenworthy, but normally confined to the Upper Sonoran Zone.

Dendromecon rigidum *Benth.* Tree Poppy.

Patches of this elegant shrub are frequently found in the chaparral belt of the west side and on Chalk Hill. It belongs to the Upper Sonoran Zone.

Dicentra chrysantha *H. & A.* Dutchman's Breeches.

Same range as the last and equally common. (No. 2630.)

Eschscholtzia Californica *Cham.* "California Poppy." Copa de Oro.

Very typical, perennial specimens of this species were collected on Chalk Hill and also on the north-west side, near the lower limit of the pines. (No. 2063.)

Platystemon Californicus *Benth.* Cream-cups.

This occasionally enters the lower part of the pine belt on the south and west sides. (Nos. 1144, 2189.)

CRUCIFERÆ.

Arabis arcuata *Gray.*

Gathered only on the south side where it is occasionally seen below the 8000-foot contour. (Nos. 2981, 2221.)

Arabis perfoliata *Lam.* *A. glabra* (L.) BERNH. Tower Mustard.

Strawberry Valley. (No. 654.)

Arabis perennans *Wats.*

On ridges near Tahquitz Peak, above 8000 ft. alt. (No. 2316, 2425.)

Arabis repanda *Wats.*

Lower part of Tahquitz Valley. (No. 2449.)

Brassica nigra (*L.*) *Koch.* Black Mustard.

Introduced in Strawberry Valley. (No. 2282.)

Capella Bursa-pastoris *Moench.* Shepherd's Purse.
Common in Strawberry Valley.

Caulanthus amplexicaulis *Wats.*
Onstatt Valley and Chino Creek, at 6500–7500 ft. alt. (Nos. 2660, 2661.)

Draba corrugata *Wats.*
This rare plant was found to be plentiful around the summit of San Jacinto Mt., where it grows among the rocks in loose, gravelly soil kept moist by lingering snowdrifts. It ranges along the west side of the mountain as far as Deer Springs, 9500 ft. alt., and was collected in a cañon just below Round Valley, of the east side, at 8800 ft. alt.

Considerable variation is exhibited in the vegetative characters. The scape-like peduncles sometimes arise from a rosette of leaves each of which measures only 3 or 4 lines long; in other specimens growing in the same locality, but probably in more sheltered positions, the leafy, branching stems are several inches high and the leaves 1½ in. long. In technical characters our specimens agree well with the co-types of *D. corrugata* with which they were compared. (Nos. 703, 2413, 2499.)

Erysimum asperum *DC.* Wall Flower.
Common from the lower edge of the pines to 9500 ft. alt. (Nos. 2339, 2479.)

Lepidium medium *Greene*, Erythea iii. 36 (1895). *L. intermedium* GRAY, of Bot. Calif., not A. RICH. Pepper-grass.
Rare on the south side and found only below 5500 ft. alt.

Nasturtium officinale *R. Br.* Water-cress.
Naturalized in stagnant water, Strawberry Valley.

Sisymbrium canescens *Nutt.* *S. pinnatum* (WALT.) GREENE, Bull. Calif. Acad. ii. 390 (1887), not BARN. Tansy Mustard.
Common in Strawberry Valley, Round Valley, etc. (No. 2623.)

The Santa Rosa Indians mix the seed of this plant with their corn meal to give it a more agreeable flavor.

Streptanthus campestris *Wats.*

Occasional in the open forests at 5500–6000 ft. alt. (No. 2243.)

Thysanocarpus curvipes *Hook.* Fringe-pod.

Beneath the pines of the south side this plant was found to occur at a few places, the highest of which was in Onstatt Valley at 6500 ft. alt. (Nos. 2027, 2217.)

CRASSULACEÆ.

Cotyledons laxa *B. & H.*

Occasional on open or rocky slopes in the vicinity of Strawberry Valley. (No. 2526.)

Sedum obtusatum *Gray.* Stone-crop.

Collected only on the walls of the rocky cañon through which Strawberry Creek dashes at 5000 ft. alt. This is along the lower limits of the Transition Zone. (No. 734.)

SAXIFRAGACEÆ.

Heuchera rubescens *Torr.* Alum Root.

This occurs plentifully with the last; also near the lower end of Hemet Lake (acc. to Mrs. F. C. R. Price), on Tahquitz Peak, and is abundant among the rocks around San Jacinto Peak. Its range is therefore from the Lower Transition to the Hudsonian Zone. (Nos. 702, 2412.)

Philadelphus serpyllifolius *Gray*, Pl. Wright. i. 77 (1852) and ii. 64 (1852).

Very common among rocks in the Upper Transition from Lake Surprise to the head of Round Valley. It is most plentiful on ridges overlooking the Colorado Desert at 8000-9000 ft. alt., where the low bushes, covered with a profusion of white flowers, are very conspicuous on the rocky walls in August and September. (Nos. 800, 2500).

This plant, the type locality of which is New Mexican, was collected on San Jacinto Mt. in 1892 by Mr. F. P. Hosp, and has

not yet been found elsewhere in California.* The San Jacinto specimens do not differ from those of the type collection, so far as can be made out from Dr. Gray's description, which is here supplemented by the following notes based on our no. 2500: Shrubby, 1–3 ft. high; leaves not fascicled but somewhat crowded on the short rigid branchlets, 4–5 or rarely 7 lines long, sparsely pubescent above, densely silky-pubescent beneath; flowers clear white, fragrant, ¾ in. across; calyx-lobes silky-pubescent externally and on the upper third of the inner surface.

Ribes amictum *Greene*, Pitt. i. 69 (1887). *R. Menziesii* PURSH., of Bot. Calif., in part. Gooseberry.

In the Lower Transition Zone. Not common and not found on the east side. (No. 2259.)

Ribes cereum *Dougl.*

A common shrub from the 8000-foot contour to the summit. (Nos. 2353, 2411.)

Ribes lacustre molle *Gray*. *R. nubigenum* McClatchie, Eryth. ii. 79 (1894).

Common on the summit and also collected at 9200 ft. alt. in Round Valley. Evidently confined to the Hudsonian Zone. (No. 2410.)

Ribes Nevadense *Kell.*, Proc. Calif. Acad. i. 65 (1873, reprint). *R. sanguineum variegatum* WATS., in part.

Frequent in moist soil throughout the Lower Transition Zone. (Nos. 2260, 2423.)

Tellima affinis *(Gray) Boland.* *Lithophragma affinis* GRAY. Star of Bethlehem.

This is a species of the foot-hills, but reaches the pine belt on the south and west sides. (No. 2187.)

* This species has been reported from San Pedro Martir, Lower California, by Mr. T. S. Brandegee, Zoe iv. 205 (1893).

ROSACEÆ.

Adenostoma fasciculatum *H. & A.* Chamisal.

This, the principal shrub of the chaparral belt, sometimes reaches an altitude of 7500 ft. on exposed south slopes. It is present, surrounded by Transition elements, on all the "Sonoran islands," described on page 37.

Adenostoma sparsifolium *Torr.* Bastard Cedar. Yerba del Pasmo.

Abundant on Chalk Hill and elsewhere in the Upper Sonoran Zone on the south and east sides. (Nos. 776, 2638.)

Amelanchier alnifolia *Nutt.* Service Berry.

Strawberry Valley; Tahquitz Valley; near Kenworthy. (No. 2422.)

Cercocarpus betulæfolius *Hook.* *C. parvifolius glaber Wats.* Mountain Mahogany.

Common in the foot-hills, and occasionally found beneath pines, but only on the south and west sides.

Cercocarpus ledifolius *Nutt.*

This is a shrub of higher altitudes, being common on ridges above the 7500-foot contour. Near Round Valley it sometimes becomes arboreous with trunks 2 ft. in diameter. It is adapted to the xerophytic conditions prevailing on these ridges by its tough branches and small, leathery leaves. (Nos. 853, 2584.)

Fragaria Californica *C. & S.* Wild Strawberry.

The Strawberry is frequently met with in the lower part of the pine belt, but not on the east side. (No. 861.)

Holodiscus discolor dumosa (*Nutt.*) *Maxim.* *Spiræa dumosa* NUTT., T. & G., Fl. i. 416 (1840) as synonym; WATS., Bot. King 80 (1871). *S. ariæfolia discolor* T. & G., Fl. i. 416 (1840). Dwarf Meadow Sweet.

Occasional along ridges at 7500–10,800 ft. alt., from Tahquitz Peak and Lake Surprise to San Jacinto Peak, where it was found growing among the summit rocks.

The specimens on the summit (no. 796) are less than 2 ft. high with leaves mostly under 4 lines in length, while the nearly

simple racemes are only an inch or two long. At lower altitudes and in better soil (no. 2465) it becomes more robust with larger leaves, but the inflorescence is scarcely different from that of specimens from the highest altitudes.

Potentilla acuminata *Hall*, sp. nov.

Perennial from a stout somewhat woody root: stems several, slender, glandular pubescent, 4 in. or less high, not scapose: leaves sparsely pubescent on both sides, the petioles glandular, pinnate with one or two pairs of sessile or short-petiolate leaflets, or all but the terminal sometimes suppressed; stipules lanceolate, acute, entire; leaflets orbicular to cuneiform-obovate, 2–6 lines wide, conspicuously toothed: flowers few; pedicels slender, 5 lines or less long: hypanthium hemispherical, 1 line wide; bractlets linear-lanceolate, acute, half as long as the narrowly ovate acuminate sepals: petals yellow, narrowly ovate, acuminate, equalling the sepals: stamens more than 20, closely inserted about the pistils: akenes 10 or more, slightly incurved at apex, the somewhat longer style attached just below the tip.

Growing from the cracks of rocks along Chino Creek, a short distance below Round Valley, San Jacinto Mt., California, at about 8000 ft. alt., Aug. 2, 1901 (H. M. Hall, no. 2605). The type is in the Herbarium of the University of California.

Nearest to *P. Grayi* Wats., from which it differs in being not at all scapose, in the pubescence, and in the shape and arrangement of the leaflets, as well as in the smaller flowers, narrower bractlets, etc. It is distinguished from *P. brevifolia* by its leafy stem, the longer petioles, the altogether different leaflets, and the much smaller flowers. The cut of the leaflets and the general appearance of this species suggest a reduced form of some member of the glandulosa group (Drymocallis Tourr.), but in technical characters it is abundantly distinct, having narrow, acuminate petals and slender styles, each of which is attached to a point near the apex of its akene.

Potentilla callida *Hall*, sp. nov.

Root thick, somewhat woody: stems several, slender, erect or ascending, 2 in. or less high, villous throughout with long hairs and also bearing some short glandular hairs above: stipules

ovate, the free portion ½ line long, entire or toothed; leaves villous, pinnate; the lower 6–10 lines long, with about 7 pairs of crowded leaflets; the upper much shorter, bract-like, with 1–5 pairs of leaflets; leaflets 1 line long, divided to the base into 2 or 3 oval segments: flowers sometimes solitary on the ends of the stems but usually 3 to 6 in a simple raceme; pedicels slender, 2–5 lines long: hypanthium saucer-shaped, 1½–2½ lines wide; bractlets narrow; sepals twice as long, narrowly ovate, acute: petals white, oblong, obtuse or acutish, narrowed at base but not clawed, a little longer than the calyx (about 1½ lines long): stamens about 20; filaments filiform: pistils several; style laterally attached, slightly longer than the glabrous akene.

Growing from the cracks of rocks, Tahquitz Peak, San Jacinto Mt., California, at 8000 ft. alt., Aug. 5, 1901 (H. M. Hall, no. 2611). The type is in the Herbarium of the University of California.

Nearest to *P. Kingii* Greene, from which it is most readily distinguished by its small size, by the villous and glandular pubescence, and by the narrow petals.

Specimens have been distributed under the name of *Horkelia callida* Hall, but on more carefully considering the validity of the genus Horkelia we have come to the conclusion that it cannot be satisfactorily separated from Potentilla and have therefore described our plant under the latter genus.

Potentilla Clevelandi *Greene*, Pitt. i. 102 (1887). *Horkelia Clevelandii* RYDB., Bull. Torr. Club xxv. 54 (1889) and Monogr. N. A. Pot. 120 (1898).

Rather common throughout the Lower Transition Zone; usually in meadows. (Nos. 648, 2291.)

Potentilla glandulosa Nevadensis *Wats.* *Drymocallis glandulosa monticola* RYDB., l. c. 199.

Collected in the Lower Transition Zone on all sides of the mountain but the east. (Nos. 2039, 2204, 2546.)

Potentilla gracilis *Dougl.* *P. Blaschkeana* TURCZ.

Found only in moist soil near Strawberry Valley. (No. 2296.)

Potentilla gracilis fastigiata *(Nutt.) Wats.* *P. fastigiata* NUTT.

This variety grows sparingly in the meadows of Thomas Valley, at 4500 ft. alt. (No. 2184.)

Potentilla gracilis rigida *Wats.* *P. Nuttallii* LEHM.

Collected in Tahquitz Valley, altitude 8000 ft. (No. 2356.)

Potentilla lactea *Greene*, Pitt. iii. 20 (1896). *P. glandulosa lactea* GREENE, Fl. Fr. 65 (1891).

Plentiful in some of the meadows of Tahquitz Valley at about 8000 ft. alt. (no. 2355, verified by Professor Greene). Also common at 9200 ft. alt. in Round Valley, where an examination of living specimens showed that the bractlets were sometimes entire and acute but usually toothed or even divided, the stamens 22–24, and the bractlets, sepals, and petals often 6 each in number. (No. 2400.)

Prunus demissa Walp. Western Choke-cherry.

In the Lower Transition on Fullers Ridge and in Onstatt Valley.

Prunus emarginata *Walp.* *Cerasus Californica* GREENE, Fl. Fr. 50 (1891). Red Cherry.

More plentiful than the last and extending nearly throughout the Transition Zone, forming dense thickets in parts of Tahquitz Valley. In pubescence this form approaches the variety *mollis* of Brewer.* The shrubs vary in height from 6 to 12 ft.

Rosa Californica *C. & S.* Wild Rose.

Along streams of the south and west sides below 6000 ft. alt.

Rubus parviflorus *Nutt.* *R. Nutkanus* MOÇ. Thimble-berry.

Common near water-courses throughout the Lower Transition and occasional in the Upper Transition, reaching an altitude of 9000 ft. in Round Valley. (Nos. 318, 782.)

LEGUMINOSÆ.

Amorpha Californica *Nutt.* *A. hispidula* GREENE, Fl. Fr. 14 (1891).

This occurs as a low shrub in the lower part of Tahquitz Valley, and in Onstatt Valley. (No. 2454.)

* Cf. Parish, Zoe iv. 342 (1894).

Astragalus Antiselli *Gray.*

Common around Kenworthy, in the lower edge of the pine belt. (Nos. 545, 2164.)

Astragalus Parishii *Gray.* Loco-weed.

Common in open pine forests of the south side below the 6000-foot contour, from which it extends down through the Sonoran Zone to the desert.

The pubescence of this species is very variable. At 6700 ft. alt. in the San Antonio Mts. it is early glabrate (no. 1248); at 5000–5500 ft. alt. on the San Jacinto Mts. it remains grayish pubescent even during the fruiting period (nos. 971, 1117, 2229); while in the lower valleys opening toward the Colorado Desert the leaves are clothed with a dense pubescence, which gives them a silvery sheen and which persists at least during the fruiting season,—perhaps permanently (no. 1158).

Lathyrus lætiflorus *Greene*, Erythea i. 105 (1893) (?)

A white-flowered Lathyrus, probably of this species, is common on hillsides in the upper part of the chaparral belt and in the lower part of the pine belt of the south and east sides. It differs from the type in being scarcely at all shrubby, in the less elongated peduncles, and in the broader leaflets. The last character is, however, extremely variable, narrowly lanceolate, acute leaflets and broadly elliptical, obtuse ones occurring on the same plant. In the chaparral the plants climb to a height of several feet,—in the open forests they are prostrate. (No. 2308.)

Lathyrus violaceus *Greene*, l. c.

The bright, reddish-purple flowers of this species are frequently seen adorning the more somber foot-hill shrubs over which it clambers. It reaches our limits in Onstatt Valley but is not found among the pines. Our specimens agree well with the type, with which they were compared, except that the stipules are nearly entire and the raceme rather loose. (No. 2222.)

Lotus Americanus *Bisch.*, Hort. Heidelb. (1839). *Hosackia Purshiana* BENTH. Spanish Clover.

Common below the 6000-foot contour. (No. 2387.)

As shown by Prof. Greene* the American genus Hosackia, of Douglas, is not well separated from the Old World genus Lotus, of Tournefort. In this list, therefore, the species are treated under the latter name, that being the older of the two.

Lotus crassifolius (*Benth.*) *Greene*, Pitt. ii. 147 (1890). *Hosackia crassifolia* BENTH.

Common along streams throughout the Lower Transition Zone. (Nos. 826, 967.)

Lotus glaber (*Vogel*) *Greene*, l. c. 148. *Syrmatium glabrum* Vogel. *Hosackia glabra* Torr. Deer-weed.

Abundant in the chaparral belt, reaching the base of Chalk Hill, and therefore confined to the Sonoran Zone.

Lotus leucophæus *Greene*, l. c. 145. *Hosackia grandiflora* (?) *anthylloides* GRAY.

Also of the chaparral belt but somewhat rare and extending well into the pine belt of the south and west sides, even to 6000 ft. alt. (Nos. 317, 557, 937, 2020.)

Lotus Nevadensis (*Wats.*) *Greene*, l. c. 149. *Hosackia decumbens* (?) *Nevadensis* WATS.

Well distributed from the lower edge of the pine belt to 9000 ft. alt. Most common in open forests where the specimens are provided with long internodes and broad leaflets. When growing in exposed places or at high altitudes the internodes are much shorter and the leaflets not one-fourth as large. (Nos. 2337, 2379, 2491.)

Lotus oblongifolius (*Benth.*) *Greene*, l. c. 146. *Hosackia oblongifolia* BENTH.

Of the same range as the last but not found above 8200 ft. alt., and confined to the vicinity of streams or wet meadows. (Nos. 2380, 2573.)

Lotus strigosus (*Nutt.*) *Greene*, l. c. 141. *Hosackia strigosa* NUTT.

Common on the lower slopes of the south and west sides, occasionally extending into the pine belt. (Nos. 2380, 2573.)

* Pitt. ii. 133 (1890).

Lupinus albifrons *Benth.* Lupine.

Frequent beneath pines and on open slopes on all sides of the mountain, sometimes reaching an altitude of 8000 ft. (No. 2213.)

Lupinus concinnus *Agardh.*

Occasional in dry woods of the lower part of the pine belt. Not seen on the north side. (Nos. 1128, 2067.)

Lupinus cytisoides *Agardh.* *L. rivularis* DOUGL., of Bot. Calif.

Throughout the Transition Zone; rare in the lower half, forming large patches in the bogs of the upper half. (No. 2554.)

Lupinus formosus *Greene*, Fl. Fr. 42 (1891).

Very common in dry, open forests from the lower edge of the pine belt to 9400 ft. alt. At the higher altitudes the pubescence is more appressed, the leaflets narrower and more elongated, the peduncles shorter and the looser racemes composed of larger flowers in indistinct verticels. (Nos. 672, 2167, 2214, 2498, 2551.)

Lupinus micranthus *Dougl.*

Abundant beneath pines on the Johnston Ranch below 4500 ft. alt. (No. 2026.)

Trifolium microcephalum *Pursh.*

Occasional in meadows below the 9000-foot contour. (No. 650.)

Trifolium monanthum *Gray.*

Common along streams and around the borders of nearly all the meadows from 5000 to 10,000 ft. alt. (Nos. 710, 1812, 2200, 2463, 2552.)

On San Jacinto Mt. this species varies somewhat from the form usually collected in the Sierras. The plants are always perennial and glabrous throughout, but the leaflets vary from obovate and obtuse to narrowly lanceolate and acute, a wide degree of variation often occurring in leaflets of a single plant. The flower is very typical except for the large size of the corolla which has a length of 6–8 lines; the banner is broad and obtuse, much exceeding the keel and slightly longer than the narrow wings. The corolla often fades to a uniform brown color, but in fresh specimens it is clear white with the black tip of the short

keel showing as a conspicuous blotch in the center. Pod obtuse, 3-seeded.

Trifolium obtusiflorum *Hook.*

Strawberry Valley, Shingle Valley, both below 5500 ft. alt. (No. 2075.)

Trifolium Rusbyi *Greene*, Erythea i. 5 (1893).

Collected only in the meadows of Tahquitz Valley at 8000 ft. alt., in the Upper Transition Zone. These specimens have the small, narrow leaflets of var. *atrorubens* Greene.* The flowers are on very short pedicels and the color is intermediate between that of the type and that of the variety. (No. 2365.)

Trifolium tridentatum *Lindl.*

Beneath pines of the south side at 4500 ft. alt. (No. 2029.)

Trifolium variegatum *Nutt.*

This species, the stems of which vary from a few inches in length when growing in dry soil to two feet or more when near streams, was found on the south and west sides up to an altitude of 8500 ft. (Nos. 2035, 2273.)

Trifolium Wormskjoldii *Lehm.* *T. involucratum* WILLD., of Bot. Calif.

Found only in meadows below 4500 ft. alt.

Vicia Americana truncata *(Nutt.) Brewer.* Vetch.

In the lower part of the pine belt of the south side. (No. 2298.)

GERANIACEÆ.

Erodium cicutarium *(L.) L'Her.* Filaree.

Commonly introduced on ranches at the lower altitudes.

Geranium Fremontii *Torr.*

Collected at several places in Tahquitz Valley with the next. (No. 722.1.)

Geranium Richardsonii *F. & T.* Wild Geranium.

Quite common in wet meadows, etc., in the Upper Transition Also collected in Strawberry Valley. (Nos. 722, 2336.)

* Erythea iv. 66 (1896).

LINACEÆ.

Linum Lewisii *Pursh.* Blue Flax.

Not rare over the south and west sides, flowering in May. Evidently confined to the Lower Transition Zone. (Nos. 554, 1811.)

EUPHORBIACEÆ.

Euphorbia hirtula *Engelm.*

Collected in dry, sandy soil; Strawberry Valley. (No. 966.)

Euphorbia Palmeri *Engelm.*

Common throughout the Transition Zone, but less frequent in the upper portion of its range. (Nos. 970, 1116, 2520.)

Euphorbia serpyllifolia *Pers.* Rattlesnake Weed.

Plentiful in the lower part of the pine belt and below. (Nos 2183, 2532.)

ANACARDIACEÆ.

Rhus trilobata *Nutt.* Squaw Bush.

Quite rare in the Upper Sonoran. Collected on Chalk Hill and on Thomas Mt.

CELASTRACEÆ.

Euonymus Parishii *Trelease*, Trans. St. Louis Acad. v. 354 (1899) and Syn. Fl. i pt. 1, 397 (1897). Spindle Tree. Burning Bush.

Found only at an altitude of about 6000 ft. in a cañon opening into Strawberry Valley from the east, this probably being the type locality. The shrubs were few in number, 8–10 ft. high, and with long, slender branches. (No. 2299.)

ACERACEÆ.

Acer glabrum *Torr.* Sierra Maple.

Only one specimen of this was found and that in a cañon of the east side below Round Valley at an estimated altitude of 7500–8000 ft. There is probably more of it in the same or neighboring cañons below our limits. (No. 2602.)

RHAMNACEÆ.

Ceanothus cordulatus *Kell.* Buck-brush.

This is an important shrub of the chaparral formation of the higher altitudes. It is occasionally found as low as 5000 ft., but is more characteristic of the Upper Transition Zone and barely enters the Canadian at 9300 ft. alt. On the higher ridges, which receive a large amount of snow in winter, the specimens often become exceedingly depressed and twiggy. Bushes from a single root will sometimes spread out over an area 15 ft. in diameter, meanwhile rising only a couple of feet from the ground. In these cases the small twigs are so numerous that the whole surface is smoothed over with the small, gray leaves, giving to the whole the appearance of an immense sofa pillow. (No. 721.)

Ceanothus cuneatus *Nutt.* Nuttall's Ceanothus.

Enters the lower part of the pine belt on the Johnston Ranch, etc.

Ceanothus divaricatus *Nutt.* Mountain Lilac.

This is a foot-hill species, but is found in the lower part of the pine belt on the south and west sides. On hill-tops near its upper limit it becomes low and scrubby, taking on the habit of normal *C. cordulatus*. All the flowers seen were blue. (No. 2223.)

Ceanothus integerrimus *H. & A.* Deer Brush.

Of higher range than the last, beginning with the pines and running through the Lower Transition Zone. (No. 775.)

Ceanothus perplexans *Trelease*, Syn. Fl. i. pt. 1, 417 (1897).

This Sonoran species is very common around the south-east base of the mountain and was found beneath the pines at a few places in Thomas Valley.

Rhamnus Californica tomentalla *B. & W.* Coffee Berry.

Found only on the south and west sides, where it rarely ascends to 8000 ft. alt. (No. 2261.)

Rhamnus crocea ilicifolia *(Kell.) Greene*, Fl. Fr. 79 (1891).

This foot-hill shrub was found extending into the pine forests of the south side. It was quite rare, however, and did not get above the 6000-foot contour.

MALVACEÆ.

Sidalcea malvæflora *Gray.* Wild Hollyhock.

Collected only in Strawberry Valley, where it is plentiful in meadows. (Nos. 315, 739.)

Sphæralcea ambigua *Gray.*

Common at lower altitudes on the south and east sides under the influence of desert conditions, but ranging up to 4500 ft. alt. in Thomas Valley. Usually 2–3 ft. high, the flowers with brick-red petals only a half-inch long and calyx 4 lines or less long. (Nos. 751, 2148.)

GUTTIFERÆ.

Hypericum anagalloides *C. & S.* False Pimpernel.

In moist soil almost throughout the Transition Zone, but not common. (No. 659.)

Hypericum formosum *HBK.* *H. Scouleri* HOOK. St. John's Wort.

Confined to streams of the Lower Transition, where it is fairly common. Not found in valleys opening upon the desert. (Nos. 665, 689, 973.)

VIOLACEÆ.

Viola blanda *Willd.* White Violet.

This species was found in nearly all the meadows of the Canadian Zone, from which it rarely follows the creeks down into the Upper Transition, in an exceptional case even to the 6000-foot contour. (Nos. 2239, 2404.)

Viola purpurea pinetorum *Greene*, Fl. Fr. 243 (1891). *V. pinetorum* GREENE, Pitt. ii. 14 (1889) and iii. 42 (1896).

Rather common beneath pines of the south side below 6000 ft. alt. (No. 555.)

STERCULIACEÆ.

Fremontia Californica *Torr* *Fremontodendron Californicum* COVILLE, Contr. U. S. Nat. Herb. iv. 74 (1893).

Collected at 5000-ft. alt. on Bull Creek, in the Upper Sonoran Zone, scarcely within our limits. (No. 958.)

LOASACEÆ.

Mentzelia congesta *T. & G.*

This species of the desert region was found in Onstatt Valley. (No. 2225.)

Mentzelia dispersa *T. & G.*

Collected only in Strawberry Valley, but probably not rare on the lower slopes. (Nos. 657, 2272.)

Mentzelia gracilenta *T. & G.*

Plentiful in Strawberry Valley and elsewhere on the south and west sides, but not above 6000 ft. alt. (Nos. 647, 1121.)

DATISCACEÆ.

Datisca glomerata *(Presl) B. & H.* Durango Root.

Below the 6500-foot contour along streams of the south side. (Nos. 834, 2381.)

ONAGRACEÆ.

Boisduvalia densiflora *Wats.*

Occasional in meadows etc. of the lower valleys. (No. 2992.)

Clarkia rhomboidea *Dougl.*

Common in the Lower Transition, flowering in May and June. On specimens growing beneath shrubs on north slopes the leaves are much wider than on those growing in the open forests. (Nos. 651, 2264, 2270.)

Epilobium adenocaulon (?) perplexans *Trelease*, Rept. Mo. Bot. Gard. ii. 96, t. 25 (1891).

Common in moist places throughout the Lower Transition. No. 2589 from the Upper Transition of Round Valley is probably this variety but is somewhat pubescent below while the pedicels and capsules are less pubescent than in the typical form. (Nos. 2378, 2562, 2640.)

Epilobium glaberrimum *Barbey; Trelease*, l. c. 104, t. 38.

This is the most common Epilobium on the mountain and ranges throughout the Lower Transition Zone. (Nos. 2377, 2563.)

Epilobium Oregonense (?) gracillimum *Trelease*, l. c. 109, t. 46.

This variety was collected in Tahquitz Valley at an altitude of 8000 ft. where the flowers, rather conspicuous for so small a plant, dot the boggy meadows with white in a few places. The plants average only 6 in. high but are otherwise quite typical. (No. 2357.)

Epilobium paniculatum *Nutt; Trelease*, l. c. 85, t. 8.

Near Strawberry Valley, in the lower part of the pine belt. (Nos. 732, 2627.)

Epilobium spicatum *Lam.; Trelease*, l. c. 80, t. 1. Fire-weed.

Found only along Tahquitz Creek at 8300 ft. alt. (No. 322.)

Gayophytum lasiospermum *Greene*, Pitt. ii. 164 (1891); *Trelease*, Rept. Mo. Bot. Gard. v. 109, t. 17 (1894).

Common in the lower part of the pine belt. (No. 2279.)

Gayophytum pumilum *Wats; Trelease*, l. c. 114, t. 22.

Common in the upper part of the pine belt and up to 9000 ft. alt. (No. 2347.)

Gayophytum ramosissimum *T. & G.; Trelease*, l. c. 111, t. 20.

According to Dr. Trelease this species has been collected on San Jacinto Mt. by Mr. Parish (July, 1881, no. 1023). It is probably quite common in the pine belt, as it is in the San Bernardino Mts., but we did not distinguish it in the field from from *G. lasiospermum*.

Godetia quadrivulnera *Spach*.

This foot-hill species is found in the lower part of the pine belt. (No. 2262.)

Œnothera bistorta *Nutt. Sphærostigma bistorta* WALP. Sun-cups.

Rarely seen; Strawberry Valley, Fuller's mill, etc.

Œnothera Californica *Wats. Anogra Californica* SMALL, Bull. Torr. Club xxiii. 176 (1896). California Evening Primrose.

In sandy soil, lower part of the pine belt of the south side. More frequent at lower altitudes. (No. 771.)

Œnothera hirtella *Greene*, Fl. Fr. 215 (1891). *Sphærostigma hirtellum* SMALL, l. c. 190.

Very common on the south and west sides of the mountain but not above the 5500-foot contour. It is probably only a variety of *Œ. bistorta* Nutt., to which it is more closely related than it is to *Œ. micrantha* Hornem., with which it has been confused by some. (No. 2089.)

Œnothera Hookeri *T. & G.* *Onagra Hookeri* SMALL, l. c. 171. *Œ. biennis hirsutissima* Gray, of Bot. Calif. Common Evening Primrose.

Near streams in the vicinity of Strawberry Valley. (No. 2639.)

Œenothera strigulosa (*F. & M.*) *T. & G.* *Sphærostigma strigulosa* F. & M., Ind. Sem. St. Petersb. ii. 50 (1835).

Rather common in the lower part of the pine belt but much less so than in the foot-hills. (No. 2179.)

Zauschneria Californica latifolia *Hook.* California Fuchsia.

Occasional throughout the Transition Zone, ascending to 9000 ft. alt. near Lake Surprise. (Nos. 808, 2330, 2503, 2567.)

UMBELLIFERÆ.

Angelica tomentosa *Wats.; C. & R.* Monogr. N. A. Umbell. 158 (1900.) Angelica.

Frequent along the lower edge of the pine belt on the south and west sides. (Nos. 740, 977, 2557.)

Eulophus Parishii *C. & R.*, Rev. N. A. Umbell. 112 (1888) and Monogr. N. A. Umbell. 111 (1900).

Not rare in meadows of the Canadian and Transition zones at 5200–8500 ft. alt. (Nos. 851, 2575.)

Heracleum lanatum *Michx.*; *C. & R.*, Monogr. N. A. Umbell. 248 (1900). Cow Parsnip.

On the northwest side at the lower edge of the pine belt.

Hydrocyotyle ranunculoides *L.; C. & R.*, l. c. 29. Floating Marsh Pennywort.

Thomas Valley, in quiet water. (2168.)

Osmorhiza nuda *Torr.* *Washingtonia nuda* HELLER, Cat. N. A. Pl. ed. 1, 5 (1898); C. & R., l. c. 64. Sweet Cicely.

Collected only at 9000 ft. alt. in Round Valley. In these specimens, which are immature, the peduncles have 3 or 4 rays and the pedicels are 6–8 lines long. (No. 2592.)

Peucedanum Mohavense *C. & R.*, Rev. N. A. Umbell. 62 (1888). *Lomatium Mohavense* C. & R., Monogr. N. A. Umbell. 234 (1900).

Common to the southeast of San Jacinto Mt., extending into the coniferous forest on Thomas Mt. (No. 1184.)

Selinum eryngiifolium *Greene*, Pitt. ii. 102 (1890). *Sphenosciadium eryngiifolium* C. & R., l. c. 128.

Rather common along streams of the Upper Transition and Canadian zones. (Nos. 720, 2600.)

Velæa arguta *(T. & G.) C. & R.*, Rev. N. A. Umbell. 120 (1888). *Deweya arguta* T. & G., Fl. i. 641 (1840); C. & R., Monogr. N. A. Umbell. 79 (1900).

Well distributed over south slopes in the Upper Sonoran and Lower Transition zones. (No. 2083.)

Velæa Parishii *C. & R.*, Rev. N. A. Umbell. 121 (1888). *Drudeophytum Parishii* C. & R., Monogr. N. A. Umbell. 82 (1900).

Evidently confined to the south side where it is frequent in pine forests of the Lower Transition, reaching its maximum altitude at 7000 ft. (Nos. 2220, 2328, 2508.)

CORNACEÆ.

Cornus Nuttallii *Audubon*. Nuttall's Dogwood.

Found only at 5700 ft. alt. on the North Fork of the San Jacinto River. This is in the Lower Transition Zone. (No. 2245.)

Cornus pubescens *Nutt.* Common Dogwood.

In the Lower Transition of the west side; rare. (No. 2236.)

Garrya Fremontii *Torr.; C & E.*, Bot. Gaz. xv. 95 (1890).

The southern limit of this Garrya was considerably extended by its discovery in Tahquitz Valley, where small bushes of it are frequently met with on the dry pine benches at 6000–7000 ft. alt.

The leaves are thinner than those of specimens from the northern part of the state, lightly pubescent when young but soon glabrate, as are the branchlets; fruit short-pedicellate, black, early glabrate. (No. 2425.)

Garrya Veatchii *Kell.*, Proc. Calif. Acad. v. 40 (1873); *C. & E.*, Bot. Gaz. xv. 95 (1890); *Parish*, Zoe v. 73 (1900).

Not rare in the Upper Sonoran and Lower Transition zones on the south side. On San Jacinto Mt., at least, this species is very distinct from the last, both in habit and in technical characters. It is a much taller and rigid, upright shrub with coriaceous leaves densely tomentose beneath. (No. 2452.)

PIROLACEÆ.

Chimaphila Menziesii *Spreng.* Pipsissewa.

This plant is very rare in Southern California and probably reaches the southern limit of its range on San Jacinto Mt., where it was found beneath the pines at several places between 5300 and 9500 ft. alt. (Nos. 646, 736.)

Pterospora andromedea *Nutt.* Pinedrops.

Occasional in pine and fir forests. (No. 2467.)

Pyrola aphylla *Sm.*

Collected in Dark Cañon and also near Lake Surprise. (No. 811.)

Pyrola picta *Sm.* White-veined Shin-leaf.

Found only in the pine belt of the west side where it is not common. San Jacinto Mt., is probably the southern limit of the range of both this species and the last.

Sarcodes sanguinea *Torr.* Snow Plant.

With the last, but much more frequent.

ERICACEÆ.

Arctostaphylos Manzanita *Parry*, Bull. Calif. Acad. ii. 491 (1887).

This species belongs to the chaparral belt but reaches up among the pines of the south side even to the 6500-foot contour.

The berries, which have an agreeable acid taste, are much prized by summer campers who utilize them in making a manzanita jelly. (Nos. 2090, 2102.)

Arctostaphylos patula *Greene*, Pitt. ii. 171 (1891).

Common in the Yellow Pine belt from Tahquitz Peak to Fullers Ridge and also along the upper limits of the chaparral belt of the east side. On these specimens and also on some from the northern Sierras the pubescence of the pedicels and bracts extends down over the younger twigs. Fruit 6 lines in diameter, nutlets irregularly coalescent, some being firmly united, while others are easily separable. (Nos. 2312, 2419.)

Arctostaphylos Pringlei (?) drupacea *Parry*, Bull. Calif. Acad. ii. 495 (1887).

Common on all sides of the mountain but confined to open forests of the Lower Transition Zone. The highest point at which it was found was on the south side of Tahquitz Ridge at about 7500 ft. alt. (Nos. 1123, 2092, 2311.)

Arctostaphylos tomentosa *Dougl.*

Characteristic of the Upper Sonoran Zone where it is an important element of the chaparral formation. Plentiful on Chalk Hill and occasionally running over into the lower part of the pine belt on the south and west sides. (Nos. 2054, 2061.)

Rhododendron occidentale *Gray*. Western Azalea.

This shrub is plentiful along all the streams of the Lower Transition Zone, where its creamy-white blossoms rival those of the Parry Lily in beauty. The first flowers appear early in June and by the last of July the flowering season is over. (Nos. 641, 964, 2241.)

PRIMULACEÆ.

Dodecatheon alpinum (*Gray*) *Greene*, Erythea iii. 39 (1895).

D. Meadia alpinum GRAY. Alpine Shooting Star.

Common in all the boggy meadows of the Upper Transition and Canadian Zones. (Nos. 326, 801, 2348.)

Dodecatheon Jeffreyi redolens *Hall*, Bot. Gaz. xxxi. 392 (1901).

This Sierran Dodecatheon was unexpectedly found at a few places on the west side of San Jacinto Mt. along streams and in wet soil at 8500–9200 ft. alt., in the vicinity of Deer Springs, this being near the lower edge of the Canadian Zone. In the specimens here collected the calyx is somewhat longer than the mature capsule. (No. 2335.)

GENTIANACEÆ.

Erythræa venusta *Gray*. Canchalagua.

Found in a few meadows of the lower part of the pine belt. (Nos. 752, 2094.)

Frasera Parryi *Torr.*

In open pine forests of the south and west sides below the 6000-foot contour. Here it is quite common and reaches its highest development, being often 4–5 ft. high and having the lower leaves in whorls of three. In the more arid districts to the southeast the specimens are much smaller, the leaves all in pairs, and the narrower inflorescence less branched. (Nos. 698, 2518.)

APOCYNACEÆ.

Apocynum androsæmifolium *L.* Dogbane.

Collected in flower at 8500 ft. alt. in Round Valley, Aug. 1. (No. 2595.)

Apocynum androsæmifolium pumilum *Gray*.

Seen at several places on Tahquitz Ridge up to 7500 ft. alt., where it grows to a height of only a few inches and was not yet in bloom on Aug. 5.

Apocynum cannabinum *L.* Indian Hemp.

Near streams in Strawberry Valley. (No. 846.)

ASCLEPIADACEÆ.

Asclepias Californica *Greene*, Erythea i. 92 (1893); *Hall*, Bot. Gaz. xxxi. 389 (1901). *Gomphocarpus tomentosus* GRAY.

The mountain form of this species is not rare in the lower part of the pine belt of the south side. (No. 2210.)

Asclepias eriocarpa *Benth.* Milkweed.

General over the south and west sides below 5500 ft. alt. and up to about 6700 ft. on the ridges, thus running higher than the last, but, like it, also common in the foot-hills. (Nos. 663, 735, 2505.)

Asclepias Mexicana *Cav.* *A. fascicularis* DECAISNE, of Bot. Calif.

Collected at Kenworthy, altitude 4500 ft. (No. 754.)

CONVOLVULACEÆ.

Convovulus villosus fulcratus *Gray.* *C. luteolus fulcratus* GRAY. Bindweed.

Common in the Lower Transition. Stems a foot or two long, prostrate, not twining.

Cuscuta Californica *Choisy.* Dodder.

On low shrubs in Strawberry Valley, where it blossoms in August. (No. 2210.)

Cuscuta subinclusa *Dur. & Hilg.*

Collected on the Johnston Ranch.

POLEMONIACEÆ.

Collomia grandiflora *Dougl.*

Collected on North Fork and near Fuller's mill, but it scarcely enters our limits. (No. 530.)

Gilia achilleæfolia *Benth.*

Common along the lower edge of the pine belt. (No. 2034.)

Gilia ciliata *Benth.* *Linanthus ciliatus* GREENE, Pitt. ii. 260 (1892).

With the last and also ranging well up into the pine belt. Plentiful in Strawberry Valley where it flowers in May and June. (No. 2231.)

Gilia densifolia *Benth.*

Occasional throughout the Lower Transition Zone. (Nos. 330, 668, 2384.)

Gilia dianthoides *Endl.* *Linanthus dianthiflorus* GREENE, Pitt. ii. 254 (1892). Fringed Gilia.

This species, so abundant along the foot-hills in early spring, was found blossoming beneath the pines of the Johnston Ranch in May and June.

Gilia glutinosa (*Benth.*) *Gray.* *Collomia gilioides* BENTH.

Collected on all parts of the mountain from 5000 to 9000 ft. alt. (No. 2450.)

Gilia inconspicua sinuata *Gray.*

In moist soil, Strawberry Valley. (1122, 2281.)

Gilia latiflora exilis *Gray.*

Common in the upper part of the chaparral belt of the south and west sides and occasionally running over into the open pine forests. (Nos. 2043, 2060, 2212.)

Some forms of this closely resemble forms of *G. tenuiflora*, but it may always be distinguished from that species by the radical leaves, which are only once-parted into slender divisions, and by the corolla, the tube of which expands abruptly to form the wide throat. At the foot of Chalk Hill, where the variety is abundant under normal conditions, specimens were collected in May, 1897, which exhibited the large flowers and shortened pedicels of typical *G. latiflora.* This change may have been produced by the fire which passed over that region the preceding autumn; at any rate it would seem to indicate that the two forms were very closely related.

Gilia Lemmoni *Gray.* *Linanthus Lemmoni* GREENE, Pitt. ii. 257 (1892).

Very plentiful in the lower part of the pine belt of the south side, and probably elsewhere, in early spring. (No. 2062.)

Gilia pharnaceoides *Benth.* *Linanthus pharnaceoides* GREENE, l. c. 254.

Common beneath the pines on the Johnston Ranch and near Fuller's mill. (No. 748.)

Gilia pungens *Benth.*

A small clump of this was found on the very summit of Tahquitz Peak, altitude 8800 ft. It was again found growing in cracks of rocks at about the same altitude on a ridge near Lake Surprise. Nearly all of the flowers found at the latter station, perhaps a hundred in number, were examined and all were abnormal in having 6 calyx-teeth, 6 corolla-lobes, 6 stamens, and a 4-celled ovary. One flower had 6 calyx-lobes, 6 corolla-lobes, one of which was linear and only half as long as the others, and 6 stamens, one of these being sterile. The capsules contained 7–8 ovules. (Nos. 2323, 2596.)

Gilia pungens Hookeri *Gray.* (?)

A form provisionally placed under this variety is well distributed along all the ridges of the Upper Transition Zone. It differs from the last in being scarcely at all cespitose, with taller, more woody stems and narrower, more rigid leaves. There is, moreover, considerable variation in what is here placed under var. *Hookeri* and there may be two good varieties on the mountain, besides what is taken for *G. pungens*. That the number of ovules cannot be used as a distinguishing character in this group was made evident by the examination of capsules from a single clump of plants growing on a peak near Lake Surprise (no. 2597). These plants were apparently all alike, but it was found that in some of the capsules none of the ovules had matured, in others there were 2–3 seeds to each cell, while in one large capsule 25 seeds were counted. A count made on some specimens growing on Tahquitz Ridge showed that some capsules had 2–3 seeds to a cell, while others had 7 to each cell. (Nos. 2329, 2418, 2597.)

Gilia tenuiflora altissima *Parish*, Eryth. vi. 90 (1898).

Common throughout the Lower Transition. Since neither the species nor the variety occurs on the higher portions of the mountain all the specimens take on the characters of the variety, which are entirely altitudinal. (Nos. 2211, 2305, 2516, 2544.)

Gilia virgata *Steud.*

Not rare throughout the Lower Transition, flowering in August and September. (Nos. 329, 2635.)

Phlox austro-montana *Coville*, Contr. U. S. Nat. Herb. iv. 151 (1893).

Collected only in Thomas Valley; very common on Santa Rosa Mt., the southeastern continuation of the San Jacinto Range. (No. 553.)

HYDROPHYLLACEÆ.

Eriodictyon Parryi (*Gray*) *Greene*, Pitt. ii. 22 (1889). *Nama Parryi* GRAY.

A good-sized patch of this grows in the upper end of Strawberry Valley, where it puts out its first blossoms early in July. (Nos. 332, 859, 972, 2502.)

Since no complete description of this species has ever been published the following field notes are added: Perennial and somewhat woody below, where the stems are often 2 in. in diameter and beset with undeveloped branches; herbaceous above, with numerous ascending branches; viscid-pubescent and ill-scented: leaves 4–8 in. long, passing into bracts above, lanceolate, remotely sinuate-toothed, acute, tapering to the sessile base, sometimes revolute: inflorescence a scorpoid cyme, varying from a few inches to a foot and a half in length; pedicels short: calyx densely glandular-pubescent with long hairs; lobes linear from a deltoid base, much longer than the shallow tube: corolla puple, slightly and gradually expanding upward; lobes short and rounded, not widely spreading; tube pubescent externally: stamens inserted on lower half of tube, unequal, two being shorter than the other three, all included: style 2-parted to the hairy base, included; ovary hispid at summit; at maturity there is a splitting of both the valves and the placentæ, so that a 4-valved capsule is formed; seeds normally 16, but many often fail to develop, black, oval, transversely ridged.

There are specimens of this plant now in the Herbarium of the University of California as follows: San Jacinto Mt., as given above; northern slope San Bernardino Mts., altitude 4000–6000 ft. (S. B. Parish, no. 3691); Swarthout Cañon, San Antonio Mts., altitude 6000 ft. (H. M. Hall, no. 1258); Palomar, San Diego Co., altitude 5000 ft. (W. L. Jepson and H. M. Hall,

1901); Kentucky Springs, Sierra Madre Mts. (J. H. Barber, no 209); Pine Cañon, Sierra Liebre, Los Angeles Co. (H. M. Hall, no. 3088). The reported range of the species extends from Goodwin, San Luis Obispo Co., where it was collected by L. Jared,* to San Pedro Martir, Lower California, where it has been found by T. S. Brandegee.†

Nemophila Menziesii *H. & A.*, Bot. Beech. Voy. 152 (1833). *Nemophila insignis* DOUGL., Trans. Hort. Soc. n. ser. i. 479 (1835). Baby-blue-eyes.

Beneath the pines in Strawberry Valley, etc., but much less common than in the foot-hills. (No. 1806.)

For the determination of the specimens of Nemophila the author is indebted to Mr. Harley P. Chandler.

Nemophila Menziesii integrifolia *Parish*, Eryth. vi. 91 (1898).

This variety was collected along the lower edge of the pine belt on both the north and south sides of the mountain. (Nos. 2044, 2266.)

Nemophila spatulata *Coville*, Contr. U. S. Nat. Herb. iv. 156 (1893).

Collected only in moist soil near streams in the forests of Round Valley at 9200 ft. alt. (No. 2046.)

Phacelia brachyloba *Gray*. *P. leucantha* LEMMON, in Greene, Pitt. i. 175 (1888).

Common along the upper part of the chaparral belt, but not on the east side. Abundant on Chalk Hill, especially on burns. (Nos. 1129, 2070.)

Phacelia circinata *Jacq. f.*; *Parish*, Zoe v. 9 (1900). *P. Magellanica* (LAM.) COVILLE, Contr. U. S. Nat. Herb. iv. 159 (1893).

This extends in various forms to an altitude of 9400 ft. (Nos. 1558, 2480.)

Phacelia distans *Benth.* Hill Vervenia.

Along the lower edge of the pine belt of the south and west sides. (Nos. 2042, 2227.)

* Acc. to T. S. Brandegee, Zoe iv. 151 (1893).

† Zoe iv. 208 (1893).

Phacelia ramosissima *Dougl.*
With the last. (No. 2284.)

Phacelia Whitlavia *Gray.* California Bluebell.
Very common in the cañons of the foot-hills and reaching to Chalk Hill and Strawberry Valley. (No. 2280.)

BORRAGINACEÆ.

Amsinckia spectabilis *F. & M.*
Collected in Strawberry Valley.

Cryptanthe ambigua *(Gray) Greene*, Pitt. i. 113 (1887). *Eritrichium muriculatum ambiguum* GRAY.
Onstatt Valley.

Cryptanthe Jonesii *(Gray) Greene*, l. c. 113. *Krynitzkia Jonesii* GRAY.
Very common below the 6000-foot contour. (No. 2052.)

Eremocarya lepida *(Gray) Greene*, l. c. 59. *Eritrichium micranthum lepidum* GRAY.
With the last and fully as common. Sometimes ascending to 7000 ft. alt. on exposed ridges. (Nos. 2051, 2487.)

Pectocarya penicillata *A. DC.*
In gravelly soil, Thomas Valley. (No. 2181.)

LABIATÆ.

Brunella vulgaris *L.* Self-heal.
Strawberry Valley; not common. (No. 652.)

Mentha Canadensis *L.* Wild Mint.
Found growing on the south side at 5500 ft. alt. (No. 733.)

Mentha viridis *L.* *M. spicata* L. Spearmint.
Thomas Valley. (No. 770.)

Monardella lanceolata *Gray.* Western Pennyroyal.
Common in open forests of the Lower Transition of the south and west sides, flowering late in summer. (Nos. 340, 2527.)

Monardella linoides stricta Parish, Erythea vii. 96 (1899).

Along the lower edge of the pine belt in Tahquitz and Thomas valleys. The variety is an altitudinal form of the species, since in the San Jacinto, San Bernardino, and San Antonio Mts. it is found at 6000–8000 ft. alt., while typical *M. linoides* belongs to the borders of the Colorado and Mohave deserts.

Monardella macrantha *Gray*, and Its Allies.

Since the range of all the Monardellas of the macrantha section is restricted to the mountain and foot-hill region extending from the San Jacinto Mts. north to the San Bernardino Mts. and south to San Diego, an attempt has been made to collect specimens of all the species, varieties, and forms belonging to this group. As a result we now have before us an interesting series which throws considerable light on the relations between the different forms. These forms may be so arranged as to exhibit certain lines of variation, the extremes of which are very unlike and might easily be taken for distinct species, as in fact they have been by some, although they are all connected by intermediate forms. The form described below under the name *M. macrantha arida*, with its almost minute leaves closely arranged on the short stems, and its small, pale flowers, seems so very distinct from the true *M. macrantha*, with its tall stems, large leaves, elongated internodes, and deep scarlet flowers an inch and a half long, that one might never think of placing them in the same species if intermediate forms were not present. There is, however, every gradation from the one extreme to the other, and, since similar gradations exist between the other widely separated forms, it has seemed best to consider them all as varieties of a single species, for which the oldest name, viz,, *M. macrantha*, has been retained.

The different varieties and forms of *M. macrantha*, as exhibited by the material at hand, are described below. For a discussion concerning the conditions which were probably the cause of certain variations in this group see p. 44. Unless otherwise stated the number cited are of the writer's own collecting.

MONARDELLA MACRANTHA *Gray*, Proc. Am. Acad. xi. 100 (1876).

Robust, stems 1–2 ft. long; pubescence sparse and spreading; internodes elongated; the larger leaves 9–14 lines long and 8 lines wide; corolla deep red, tube somewhat trumpet-shaped, apparently glabrous but short-pubescent under a strong hand-lens; stamens exserted beyond the corolla-lobes. In our specimens the corollas are 1¼–1¾ in. long, but there is figured in Hook. f. Bot. Mag. t. 6270 a form with corolla only an inch long.

Palomar, San Diego Co., on shaded hillsides beneath chaparral, May, 1901 (W. L. Jepson and H. M. Hall, H. M. H. no. 1936); Mill Creek, San Bernardino Co., July, 1898, (S. B. Parish, no. 4578).

MONARDELLA MACRANTHA TENUIFLORA (*Wats.*) *Gray*, Syn. Fl. ii. pt. 1, 459 (1886). *M. tenuiflora* WATS., in Gray, Proc. Am. Acad., xvii. 230 (1882). PLATE XI.

Stems about a foot long, more pubescent than in the last, the pubescence not appressed; internodes long; leaves ovate, the larger 10–14 lines long; corolla pale rose or yellowish, the tube slender and more pubescent, 1¼–1½ in. long; stamens not exserted beyond the corolla-lobes.

Cañon of the San Jacinto River at 4400 ft. alt., on shaded hillsides of the chaparral belt, June, 1897 (no. 669), July, 1897 (no. 687), July, 1898 (no. 976); Palomar, San Diego Co., July 5, 1896 (A. J. McClatchie); Palomar, July 3, 1896 (A. J. McClatchie). The last is intermediate between this form and the next.

MONARDELLA MACRANTHA pinetorum *Hall*, var. nov. PLATE XII.

Stems shorter than in the last, ashy-pubescent, the hairs short and dense; internodes sometimes short with as many as five pairs of leaves crowded on a stem only an inch and a half long, sometimes more elongated; leaves ovate to elliptic, much reduced in size, the largest under 6 lines in length; corolla very slender, pale yellow to almost white, 1–1¼ in. long, conspicuously pubescent; stamens not exserted beyond the corolla-lobes.

In the Yellow Pine belt of San Jacinto Mt., at 6000 to 8000 ft. alt., July, 1897 (no. 725, type), July, 1897 (no. 691), June,

1901 (no. 2258), July, 1901 (no. 2559); San Jacinto Mt., July, 1880, (S. B. Parish, no. 327). The last has ascending or erect stems, elongated internodes and leaves 6–9 lines long; while nos. 2258 and 2259, of the author's collecting, connect this variety directly with the last preceding. The type is in the Herbarium of the University of California.

MONARDELLA MACRANTHA **arida** Hall, var. nov. PLATE X.

Very similar to the last, the stems always short and the foliage congested; leaves even more reduced, the largest only 5 lines long while the majority are only 1 or 2 lines long; corolla as in the last but still more slender and under an inch in length.

In the desert region to the southeast of San Jacinto Mt., along Coyote Creek, at 5000 ft. alt., June, 1901 (no. 2127, type), May, 1899 (no. 1180), May, 1901 (W. L. Jepson and H. M. Hall, H. M. H. no. 1852); near Palm Cañon, eastern base of San Jacinto Mt., at 4000 ft. alt., May, 1901 (W. L. Jepson and H. M. Hall, H. M. H. no. 1852). The type is in the Herbarium of the University of California.

MONARDELLA MACRANTHA NANA *Gray*, Syn. Fl. ii. pt. 1, 459 (1886.) *M. nana* GRAY, Proc. Am. Acad. xi. 101 (1876).

This variety differs from *M. macrantha* in the pale rose-colored corolla, which is only slightly exserted from the calyx-tube. No intermediate forms between the two are at hand, although they undoubtedly exist. We have it only from near the type locality of *M. macrantha*.

Cuyamaca Mts., at 4500 ft. alt., May, 1899 (no. 1202).

Monardella odoratissima *Benth*.

Common on hill-sides from 7500 ft. alt. to the very summit of San Jacinto Peak. (Nos. 712, 2486.)

Salvia carnosa compacta *Hall*, nom. nov. *Audibertia incana pachystachya* GRAY, Syn. Fl. ii. pt. 1, 461 (1886). *A. pachystachya* PARISH, Eryth. vi. 91 (1898). *Ramona pachystachya* HELLER, Muhlenbergia i. 4 (1900).

Since no adequate description of this variety has ever been published the following field notes, taken on specimens found growing in the chaparral belt of the southeast side of San Jacinto Mt., are here reproduced (no. 2160): Woody at base,

$1\frac{1}{2}$–3 ft. high, minutely puberulent: leaves obovate to spatulate, 2 in. long including the petiole: inflorescence compact, the verticels usually approximate; bracts highly colored, often nearly an inch in length, broadly oblong, very obtuse and frequently cuspidate: flowers short-pediceled, sometimes over an inch long and well exserted from the bracts: middle lobe of lower lip of corolla enlarged and 2-parted, lateral lobes broad, obtuse; upper lip of two short oblong lobes; all the lobes fimbriate margined: lower stamens carried up to mouth of corolla-tube from which they continue to ascend while the lower lip turns off at right angles, lower branch of connective lacking; upper stamens reduced to mere needle-shaped scales, barely exserted.

A series of twenty-five numbers of *S. carnosa* and its varieties from Southern California exhibit all degrees of variation and furnish conclusive evidence that the variety *compacta* is not deserving of specific rank. The specimens described above are remarkable for their long corollas, but in others from Tahquitz Valley and from the San Bernardino Mts., the corolla is only slightly exserted and in some cases it is shorter than the bracts.

On San Jacinto Mt. *Salvia carnosa compacta* is not rare beneath pines in the lower part of Tahquitz Valley, reaching an altitude of 8500 ft. on the ridges near Tahquitz Peak and Lake Surprise, while it ranges at least as low as 4500 ft. alt. in the chaparral belt of the east side.

This variety has been transferred to a species of Salvia for the following reasons: The name Audibertia was first given by Bentham* in 1829 to a genus of Labiatæ which he afterward considered as a mere section of Mentha. But desiring to preserve Audibert's name in botanical literature he in 1831 applied it to the group of plants to which the one here considered belongs, describing ***Audibertia incana*** as the first species.† Some botanists, however, still consider the section of Mentha (= Audibertia Benth., 1829) to be of generic rank, and designate it by its original name, that is, Audibertia. It would, therefore, be advisable to adopt some other name for the group of plants now under

*** Edwards Bot. Reg. subt. 1282 (1829).**

† l. c. t. 1469 (1831).

consideration. Briquet* has done this by extending the characterization of the genus Ramona of Greene† so as to include all the species of this group. There is, however, no satisfactory character on which to separate Ramona, as adopted by Briquet, from Salvia.‡ The chief distinction is in the development of the connective between the anther-cells, but this difference is one of degree, not of kind, as shown by the gradation from the large, spoon-shaped connective, such as we have in *S. pratensis* L. through the straight, only slightly elongated connective, as in *S. officinalis* L., and the mere peg, such as occurs in *S. Californica* Jepson (*Audibertia polystachya* Benth.), to those species in which the lower branch of the connective is wholly suppressed, the junction of the connective with the filament showing as an oblique joint. The last condition is found in such species as *S. Palmeri* Greene (*Audibertia Palmeri* Gray). The genus Ramona, as extended by Briquet, is therefore unnecessary and our plant is best disposed of under Salvia. Since the name *pachystachya* has already been used in the genus another has been selected.

Salvia Columbariæ *Benth.* Chia.

Common along the roads of Strawberry Valley. Also at Kenworthy. (No. 2288.)

Scutellaria angustifolia *Pursh.* Skull-cap.

Very common throughout the pine belt, beginning to blossom the first of June, but more abundant in August and September. (No. 334.)

Scutellaria Bolanderi *Gray.*

This species grows sparingly along the creeks at 4000-6000 ft. alt., rarely following them down as low as 2000 ft. alt. (Nos. 667, 696.)

Stachys albens *Gray.*

This was collected only along Tahquitz Creek in the upper part of the pine belt.

*Bull. Herb. Boiss. ii 439 (1894), and in Engler and Prantl, Nat. Pflanzenfam. iv. ab. 3a, 287 (1895).

† Pitt. ii. 235 (1892) and 301 (1892).

‡ Cf. Greene, Pitt. ii. 233 (1892).

Stachys bullata *Benth.* Hedge Nettle.

Common along streams of the Transition Zone. (Nos. 2295, 2385.)

Trichostema micranthum *Gray.* Small-flowered Blue-curls.

This plant, which possesses the same strong odor as *T. lanceolatum*, of which it is possibly only a variety, is frequently found throughout the pine belt and up to 8200 ft. alt., where it was collected on the shores of Lake Surprise. (Nos. 822, 2620.)

SOLANACEÆ.

Nicotiana attenuata *Torr.* Wild Tobacco.

This plant was found at Fuller's mill and in Strawberry Valley.

Solanum Xanti *Gray; Parish*, Proc. Calif. Acad. ser. 3 (bot.) ii. 167 (1901). Blue Nightshade.

Not rare in the pine belt, up to 8200 ft. alt. (No. 2263; determined by Mr. S. B. Parish.)

Solanum Xanti glabrescens *Parish, l. c.* 169.

This variety reaches our limits only along the lower borders, where it comes from the foot-hills. The small size and thickness of the leaves are undoubtedly due to the strong light which they receive, since it grows on exposed slopes, while the species is found only beneath shrubs or trees of higher altitudes. (No. 2071; determined by Mr. S. B. Parish.)

SCROPHULARIACEÆ.

Adenostegia Nevinii *(Gray) Greene*, Pitt. ii. 181 (1891). *Cordylanthus Nevinii* GRAY.

This species begins at about 5200 ft. alt. and extends over the south and west sides of the mountain to an altitude of 8500 ft. It was not found on the north or northeast sides. (No. 2619.)

Adenostegia rigida *Benth.* *Cordylanthus filifolius* NUTT. Bird's Beak.

Collected on all sides of the mountain in the lower part of the pine belt. (No. 2621.)

Antirrhinum Coulterianum *Benth.* Snapdragon.

Reaches to the lower edge of the pine belt on the south and west sides.

Castilleia foliolosa *H. & A.* Wooly Painted Cup.

Collected on the exposed slopes of Chalk Hill. (No. 2084.)

Castilleia miniata *Dougl.*

A tall form of this species is common all over the mountain from 5000 to 9000 ft. alt., limited to streams in the lower part of its range but growing on open hill-sides along its upper limits. (Nos. 2373, 2547, 2582.)

Castilleia parviflora *Bong.*

Less common than the last and restricted to the higher valleys where it grows in drier soil. In Tahquitz Valley *C. miniata* is abundant in the wet meadows; *C. parviflora* on the pine-clad slopes surrounding the meadows. (No. 2580.)

Castilleia stenantha *Gray.* Painted Cup.

Collected at 6500 ft. alt. in Onstatt Valley; also, at lower altitudes, in Strawberry Valley and on Snow Creek. (No. 2542.)

Collinsia bicolor *Benth.* Chinese Houses.

This Collinsia extends into the lower part of the pine belt from the foot-hills, where it is abundant, but was not found on the east side of the mountain. (No. 2052.)

Collinsia parviflora *Dougl.*

Common in moist soil in the vicinity of Strawberry Valley and perhaps elsewhere, blossoming in May. These specimens are smaller than those usually collected, but they are otherwise very typical. The occurrence of this species elsewhere in Southern California has not yet been reported. (Nos. 1119, 1810.)

Diplacus longiflorus *Nutt.* *Mimulus glutinosus brachypus* B. & W.

Not rare along the upper edge of the chaparral belt on all sides of the mountain. (No. 2077.)

Limosella aquatica *L.* Mudwort.

Very plentiful on the shores of Lake Surprise, 9000 ft. alt. Plants growing in moist sand have spatulate leaves with broad tips; those growing in shallow water have leaves which are filiform, or only slightly dilated at the tip. (No. 2494.)

Mimulus brevipes *Benth.*

More common than the last and reaching well into the pine belt, but not seen on the east side. (Nos. 777, 2058.)

Miumlus cardinalis *Dougl.* Scarlet Monkey-flower.

Occasional along streams to 6000 ft. alt. (No. 2382.)

Mimulus exilis *D. & H.* *M. pilosus* (BENTH.) WATS.

Plentiful in moist soil up to 9000 ft. alt. (No. 2586.)

Mimulus floribundus *Dougl.*

Common in moist places, even to 8500 ft. alt. (Nos. 2186, 2202, 2579.)

Mimulus Fremonti *Gray.*

This beautiful but malodorous little Mimulus is common, both along water-courses and on open slopes, up to 6000 ft. alt. (No. 2230.)

Mimulus Langsdorfii nasutus (*Greene*) *Jepson*, Fl. W. Mid. Calif. 407 (1901). *M. nasutus* Greene, Bull. Calif. Acad. i. 112 (1885).

In moist soil of the south and west sides at the lower altitudes. (Nos. 2190, 2201.)

Mimulus Langsdorfii Tilingi (*Regel*) *Greene*, Lond. Journ. Bot. xxxiii. 8 (1895); *M. Tilingi* REGEL, Gartenfl. xviii. 321, t. 631 (1869) and xix. 290, t. 665 (1870); not *M. Tilingi* of Bot. Calif., nor of GREENE, Bull. Calif. Acad. i. 110 (1885).

Common along streams and in wet meadows between 7500 and 9500 ft. alt. (Nos. 709, 2403, 2471, 2472.)

At the head of Tahquitz Valley two distinct forms of this variety grow within a short distance of each other. On a rather steep hillside we find a meadow formation, and just above this a formation of shrubby plants. Along the rivulets flowing through the meadow typical specimens of *M. Langsdorfii Tilingi*

are abundant (no. 2471). Only a few feet above, but in the shade of larger plants, occurs a form (no. 2472) in which the stems are twice as high, the internodes elongated, the stems and leaves more nearly glabrous, the upper sessile nearly orbicular leaves much thinner and larger (1½ in. long), and the peduncles more elongated. No difference in the floral characters could be detected, except that the flowers in the latter form were somewhat larger than in the other.

Mimulus moschatus longiflorus *Gray.*

Near streams throughout the Transition Zone. (No. 805.)

Mimulus Palmeri *Gray.*

This species occurs rather rarely in damp sand and along the streams up to an altitude of 6000 ft., often accompanied by *M. Fremonti*. (No. 2230.)

On examining these specimens it was noticed that in all cases the style was pubescent. This was unexpected, since one of the characters used to distinguish the section Eumimulus, to which the present species belongs, from Eunanus is that of the glabrous style. An examination of all the material at hand (some fifteen sheets) of *M. Palmeri* was therefore made, with the result that a majority of the specimens were found to have pubescent styles. Certain other characters were found varying somewhat parallel with this. The following forms may be distinguished:

(a) Style glabrous, filaments glabrous, anthers ciliate, calyx-lobes acutish and ciliate. The following collections belong here: San Bernardino Mts., June, 1892 (S. B. Parish, no. 2443); San Antonio Mts., June, 1900 (H. M. Hall, no. 1449); Sequoia Mills, Fresno Co. (T. S. Brandegee). In the last, however, the anthers are glabrous.

(b) Style pubescent, filaments pubescent, anthers glabrous, calyx-lobes very obtuse or truncate, cuspidate and not ciliate. The following belong here: San Jacinto Mt., June, 1897 (G. F. Reinhardt); Palomar, May, 1901 (W. L. Jepson and H. M. Hall, H. M. H. no. 1959); San Jacinto Mt., May, 1899 (H. M. Hall, no. 1281); San Jacinto Mt., June, 1901 (H. M. Hall, no. 2230). In the last the calyx-teeth are occasionally beset with a few ciliate hairs.

(c) Like the last except that the filaments are often all glabrous. The following exhibit this combination of characters: San Pedro Martir, Lower California (T. S. Brandegee); near Elsinore, Riverside Co. (A. J. McClatchie, no. 96).

Mimulus primuloides *Benth.*

In moist meadows. Most abundant in the Canadian and Upper Transition Zones, but also found in the Lower Transition of Strawberry Valley. Our specimens fall under *M. pilosellus* Greene,* but that can be considered at most as only a variety, since it passes by all gradations into typical *primuloides*. (Nos. 708, 2349.)

Mimulus rubellus *Gray*. *Eunanus Breweri* GREENE, Bull. Calif. Acad. i. 101 (1885) (?)

In sandy soil near streams or in meadows at 7500–9000 ft. alt. The corolla differs from the usual descriptions, as shown by the field notes taken on no. 2488 collected at Lake Surprise: "Upper lip of corolla of two entire lobes; lower lip of three emarginate lobes, or sometimes only the middle lobe emarginate." A few yellow-flowered specimens were found growing among the red-flowered ones. (Nos. 2346, 2488.)

Orthocarpus lasiorhynchus *Gray*.

Meadows, Strawberry Valley. (No. 649.)

[ORTHOCARPUS PARISHII *Gray*. The type locality of this species as given by Gray is in the San Jacinto Mts., but according to Parish† the type material came from the Cuyamaca Mts. The northernmost station at which it has yet been collected is Palomar Mt., 30 miles southwest of San Jacinto, where it is plentiful in some of the meadows.]

Orthocarpus purpurascens *Benth.* Owl's Clover.

This plant, so abundant on the plains in springtime, forms red patches beneath the pines of the Johnston Ranch, 4400 ft. alt., but it scarcely gets higher. (No. 2928.)

Pedicularis semibarbata *Gray*.

Fairly common from the middle of the Transition Zone to the

* Eryth. iv. 42 (1896).

† Zoe v. 118 (1901).

very summit of the mountain, where it grows sparingly in the shelter of the large rocks. It prefers, however, the shade of the denser pine and fir forests, and is usually found spreading its rosette of leaves over a dense carpet of pine or fir needles. (Nos. 792, 2593.)

Pentstemon Bridgesii *Gray.*

Occasional from the chaparral belt to an altitude of 8000 ft. (Nos. 2238, 2302, 2333.)

Pentstemon centranthifolius *Benth.* Scarlet Bugler.

Very common in the lower part of the pine belt, reaching its highest point on the west side at 8500 ft. alt. (No. 2276.)

Pentstemon labrosus *Hook.* Rabbit Ears.

More abundant and of higher range than *P. Bridgesii* with which it is often associated and which it resembles. In Strawberry Valley the first blossoms appear late in June and by the middle of July the open forests are aflame with its flowers. It is found on all sides of the mountain and up to 9100 ft. alt., but scarcely enters the Canadian Zone. (Nos. 969, 2506.)

Pentstemon Palmeri *Gray.*

Small patches of this species were seen here and there but it is by no means common. It is confined to the Transition Zone. (Nos. 737, 2271, 2548.)

Pentstemon Parishii *Gray.*

Along the lower edge of the pine belt on Fullers Ridge, also in the cañon of the San Jacinto River. (No. 2267.)

As compared with *P. spectabilis* the flowers of this species are more slender and less contracted at the tube, the lobes are of the same shape but smaller and the corolla is glabrous; the filaments are also glabrous, while in *P. spectabilis* the sterile filament is often, and the others sometimes, more or less pubescent, although not so described. In the color of the corolla it is intermediate between that species and *P. centranthifolius*, being scarlet with tints of blue on most of the flowers. In the leaf also it is intermediate between these, having the shape of *P. centranthifolius* but with the irregularly toothed margin of *P. spectabilis.* Since both of these species are common in the region the possibility of a hybrid origin for *P. Parishii* suggests itself.

Pentstemon Rothrockii *Gray.*

The low bushes of this Pentstemon were quite frequent in the open forests from Tahquitz Valley to Fullers Ridge, occupying the upper part of the Transition Zone. (Nos. 704, 2588.)

The corolla is not glabrous, as described, but conspicuously though sparsely pubescent externally and is of a dull yellow color veined with purple,—never "reddish".

Pentstemon spectabilis *Thurb.*

This foot-hill species is very conspicuous on Chalk Hill and elsewhere on the south and west sides but does not extend into the pine forests. (No. 2069.)

Pentstemon ternatus *Torr.*

Climbing over bushes along the border between the Sonoran and Transition zones in the vicinity of Strawberry Valley. (Nos. 335, 2634.)

Scrophularia Californica *Cham.* Figwort.

This is also supposed to be a Sonoran plant, but was found to extend to the upper limits of the Transition Zone, where it was observed at 8500 ft. alt. near Deer Springs. It is rare, however, in the pine belt.

Veronica alpina *L.*

Credited to the San Jacinto Mts. by Mr. Parish,* but not seen by us.

Veronica peregrina *L.* Neckweed.

In meadows, Onstätt Valley.

Veronica serpyllifolia *L.* Speedwell.

Collected on Squirrel Creek and in Tahquitz and Round valleys. (Nos. 2240, 2361.)

OROBANCHACEÆ.

Aphyllon fasciculatum *Gray.* Cancer-root.

Near Strawberry Valley and also in Round Valley. (No. 2599.)

* Zoe iv. 165 (1893).

PLANTIGINACEÆ.

Plantago Patagonica gnaphaloides (*Nutt.*) *Gray.*

Collected at Kenworthy. (No. 1921.)

RUBIACEÆ.

Galium angustifolium *Nutt.*

Common throughout the Lower Transition Zone. (No. 2509.)

Galium Aparine *L.* Bed-straw. Cleavers.

Not so common as the last and confined to the neighborhood of streams. Not seen on the east side. (Nos. 2091, 2283.)

Galium Californicum *H. & A.*

Found only on the west side at the lower edge of the pines. (No. 645.)

Galium multiflorum *Kell.*

Common among and on rocks around Tahquitz and Round valleys, in the Upper Transition Zone, fruiting in August. (Nos. 825, 2424, 2598.)

Kelloggia galioides *Torr.*

Plentiful in the lower part of Tahquitz Valley; also collected near Strawberry Valley, both localities being in the Lower Transition Zone.

CAPRIFOLIACEÆ.

Lonicera hispidula subspicata *(H. & A.) Gray.* Wild Honeysuckle.

Common, extending up into the pine belt of the west side to an altitude of 6200 ft. (No. 2529.)

Sambucus Canadensis Mexicana *(Presl.) Sargent*, Sylva v. 88 (1893). *S. Mexicana* Presl., in DC. Prodr. iv. 322 (1830). *S. velutina* D. & H., Journ. Phil. Acad. n. ser. iii. 39 (1854) and Pac. R. Rept. v. pt. 3, 8 (1855). Mexican Elder.

Upper Onstatt Valley, Strawberry Valley, Mistake Cañon (8500 ft. alt.). (Nos. 2216, 2517.)

The occurrence of this Elder in Southern California renders the identity of the Californian *S. velutina* with the Mexican variety of *S. Canadensis* more probable than formerly.*

Symphoricarpos Parishii *Rydb.*, Bull. Torr. Club xxvi. 545 (1899).

Frequent in Tahquitz and Round valleys in the upper part of the Transition Zone and in the lower part of the Canadian, reaching an altitude of 9500 ft. at the head of Round Valley. (No. 2485.)

This has commonly passed for *S. oreophilus* Gray but is more closely related to *S. rotundifolius* Gray, as pointed out by Dr. Rydberg. The shrubs are often 3 or 4 ft. high with long spreading branches which are not infrequently spread out over large rocks; leaves always narrow at base but variable as to apex, both acute and very obtuse leaves occurring on the same stem; corolla-lobes obtuse, half as long tube, transparent; tube fully as pubescent within as in *S. rotundifolius*.

VALERIANACEÆ.

Plectritis macrocera *T. & G.* *Valerianella macrocera* GRAY.

South side at 5200 ft. alt. (No. 1126.)

CUCURBITACEÆ.

Cucurbita fœtidissima *HBK.* *C. perennis* GRAY. Mock-orange.

Barely enters the pine belt of the west side.

Echinocystis macrocarpa *Greene*, Bull. Calif. Acad. i. 188 (1885). *Megarrhiza Californica* WATS., of Bot. Calif., in part. Chilicothe. Big-root.

Same range as the last but usually climbing over shrubs. (No. 2188.)

* Cf. *Parish*, in Zoe v. 118 (1901).

CAMPANULACEÆ.

Heterocodon rariflorum *Nutt.*

Collected along Strawberry Creek and near Fuller's mill. (No. 2205.)

Nemacladus longiflorus *Gray.*

Abundant along the lower edge of the pine belt of the south and west sides. (Nos. 661, 2047.)

Since we have no published description of the corolla in Nemacladus the following field notes taken on no. 2047 are here inserted: Corolla white with a yellow spot at base of upper lip, tube inclined to be veined with pink and lobes often tipped with pink; tube twice as long as calyx; corolla-lobes abruptly spreading at right-angles to tube, the three upper standing close together, the two lower much smaller, removed from the upper and from each other, all pubescent above; stamineal column exserted, bearded just below the anthers.

N. ramosissimus montanus *(Greene) Gray.* *N. montanus* Greene, Bull. Calif. Acad. i. 197 (1885).

Collected only in loose soil beneath trees of the Coulter Pine on Chalk Hill at 5000 ft. alt. (No. 2046.)

The following field notes were taken on this variety: Corolla white, pubescent within; tube equaling calyx; corolla lobes equal, the three upper straight, the two lower folded obliquely back on themselves like the corners of a collar, thus exposing the stamineal column; filaments slightly pubescent at base and sparsely long-bearded at top.

COMPOSITÆ.

Achillea millefolium *L.* Yarrow.

The Yarrow occurs everywhere throughout the Transition Zone. (No. 2507.)

Ambrosia psilostachya *DC.* Ragweed.

This species, known by the Indians as Yerba Sapo, or Toad Plant, is a wayside weed in Strawberry Valley.

Anisocoma acaulis *Gray.*

Occasional in the lower part of the Transition Zone and below. The long, prostrate peduncles spread out from the rosette of leaves like the spokes of a weeel and bear on their upturned tips the showy yellow heads, thus giving character to the gravelly hill-sides on which they occur. When growing in partial shade the peduncles are ascending or erect. (No. 1807.)

Antennaria speciosa *E. Nelson.* Proc. U. S. Nat. Mus. xxiii. 705 (1901).

This rare and beautiful plant forms large mats in the upper end of Round Valley at 9200 ft. alt. and in the south end of Tahquitz Valley at 8500 ft. alt.; it also grows in scattered patches on Fullers Ridge and in Tahquitz Valley at altitudes of 6500–7200 ft. (Nos. 718, 2401.)

Aplopappus interior *Coville.* Proc. Biol. Soc. Wash. vii. 65 (1892) and Contr. U. S. Nat. Herb. iv. 121 (1893). *Stenotus interior* GREENE, Eryth. ii. 72 (1894).

Common along the borders of the Colorado Desert, reaching our limits only along the edge of the chaparral belt of lower Tahquitz Valley and among the rocks at Kenworthy. The plants do not attain a height of more than about three feet in this region. (No. 1140.)

Aplopappus Palmeri *Gray.*

This species was found at a few places in Onstatt and Hemet valleys, below 5500 ft. alt. (No. 2232.5.)

Artemisia dracunculoides *Pursh.*

Occasional along streams up to 8200 ft. alt. (No. 2622.)

Artemisia heterophylla *Nutt.* California Mugwort.

This is another rather common weed of the streams but was not found above 6000 ft. alt. (No. 2633.)

Artemisia tridentata *Nutt.* Sage-brush.

The true Sage-brush covers large areas in the Upper Sonoran Zone to the southeast of San Jacinto Mt., and is also common beneath the Yellow Pines of the Transition Zone in Thomas Valley.

Aster Andersonii *Gray.* Sierra Aster.

The only known station for this Aster in Southern California is Tahquitz Valley, where it is very common and conspicuous in the more boggy parts of the meadows between 8000 and 9000 ft. alt., being thus limited to the Upper Transition Zone. In the Sierras it is more common in the Canadian Zone, where it also inhabits moist meadow lands. (Nos. 780, 2574.)

Aster Fremonti Parishii *Gray.*

Collected only in the meadows of Strawberry Valley; August. (No. 2625.)

Bæria gracilis *Gray.* Gold Fields.

This Sonoran species was collected in Thomas Valley.

Bigelovia graveolens glabrata *Gray.*

Common all over the mountain from the lower part of the pine belt up to 9500 ft. alt., blossoming from August to October. (No. 2530.)

Brickellia Californica *Gray.*

Among the rocks above Strawberry Creek at 5000 ft. alt. (No. 2391.)

Carduus Californicus (*Gray*) *Greene*, Proc. Acad. Phila. for 1892, 359 (1893). *Cnicus Californicus*, Gray. *Cirsium Californicum* Gray. Thistle.

Scattered throughout the Lower Transition Zone of the south and west sides. (No. 2286.)

Carduus Drummondii acaulescens *Gray.* *Cirsium acaule Americanum* Gray.

This peculiar thistle, which usually produces several sessile heads of flowers in the center of the rosulate cluster of radical leaves, is quite frequently found in meadows of the south side at 4400–6000 ft. alt. (No. 2421.)

Chænactis lanosa *DC.* Pin-cushion.

Very common beneath the pines at Kenworthy. At higher altitudes its place is taken by *C. tenuifolia.* (No. 2165.)

Chænactis Parishii *Gray.*

Collected on Tahquitz Ridge at 7200 ft. alt. and in the lower part of the pine belt of Tahquitz Valley 6000 ft. alt. It has been

Gnaphalium Chilense *Spreng.* Cotton-batting Plant.

Only occasional, at altitudes less than 6000 ft. (No. 2609.)

Gnaphalium palustre *Nutt.* Lowland Cudweed.

This woolly little composite is gregarious along stream-banks in Strawberry and Tahquitz valleys and in damp gravel on the shores of Lake Surprise. (No. 2666.)

Helenium Bigelovii *Gray.* Sneezeweed.

Near streams throughout the Transition Zone, but by no means common. At the head of Tahquitz Valley, 8700 ft. alt., the large heads form conspicuous yellow patches in the boggy hillside meadows. (Nos. 848, 2467.)

Helianthus Parishii *Gray.* Parish Sunflower.

Rare along water courses around Strawberry Valley. (No. 2612.)

Hemizonella minima *Gray.*

In May this plant is common beneath the pines of the south side at about 5200 ft. alt. It has not been previously reported from Southern California, but was collected by A. J. McClatchie on Wilsons Peak, May, 1896. Perhaps, because of its small size and early flowering period, it has been overlooked. (No. 1802.)

Hemizonia Wrightii *Gray.* Tarweed.

Collected only twice; the first time at 4400 ft. alt., the second at 5200 ft., both stations being within the pine belt of the south side of the mountain. (Nos. 2420, 2657.)

Hieracium albiflorum *Hook.* Hawkweed.

The long, straggling stems of this weed are occasionally seen in the upper half of the Transition Zone. (No. 817.)

Hieracium horridum *Fries.*

More common than the last and usually at higher altitudes, reaching into the Canadian Zone at Deer Springs. It was not found except in the cracks of large rocks or in decomposed granite at their bases. (Nos. 814, 2560.)

Hulsea heterochroma *Gray.*

Rare, found only on Chalk Hill, and not more than half a dozen plants in all. These viscid, and exhaling a rank, disagree-

able odor; robust, the main stem 5 ft. high, the branches simple, ascending, the lower 1½ ft. long; the larger leaves 7 in. long by 2 in. wide; heads racemosely disposed on the branches, the peduncles sometimes 1½ in. long. (No. 2048.)

Hulsea vestita callicarpha *(Wats.) Hall*, comb. nov. *H. callicarpha* Wats., in Gray, Syn. Fl. i. pt. 2, 342, as synonym. El Caparossa.

Stems several, from an annual or biennial root, branching above, 1½–3 ft. high, woolly below, viscid hirsute above; basal leaves numerous, clothed with a dense tomentum, obovate, spatulate; the rameal scattered, broadly oblong, 1–1½ in. long, passing above into bracts of the much elongated peduncles: involucre 5 lines high; rays yellow, the ligule 3 lines long;—otherwise as in the species.

Thomas Valley, San Jacinto Mt., California, at 4550 ft. alt., May 26, 1899 (H. M. Hall, no. 1180.1, type.) The type is in the Herbarium of the University of California.

Not rare in sand washes, on open hillsides, and beneath pines, on the south side, at 4400–9000 ft. alt., varying toward typical *H. vestita* in the upper part of its range. We have examined the following specimens from this region: July, 1880 (S. B. Parish, nos. 531 and 531a, the latter being a co-type of the undescribed *H. callicarpha* Wats.); June, 1882 (S. B. Parish, no. 531); July 5, 1895 (A. W. Anthony); May, 1901 (W. L. Jepson, no. 1317); May, 1899, and May to Aug., 1901 (H. M. Hall, nos. 1180.1, 1808, 2313, 2334, 2682). It has also been collected on Cuyamaca Peak, July 7, 1894 (T. S. Brandegee), and on Palomar Mt., Aug. 1, 1898 (T. S. Brandegee).

This variety is intermediate between *H. vestita* and *H. Californica*, differing from the former mainly in the less-enduring root and in the taller, more branched and somewhat leafy stems, while from the latter it is distinguished by its smaller rameal leaves, elongated peduncles and smaller heads, these bearing shorter and less conspicuous rays. Nos. 2313 and 2334, of the author's collecting from altitudes of about 9000 ft. approach *H. vestita* in having the leaves much reduced on the scape-like stems.

Layia glandulosa *H. & A.* *Blepharipappus glandulosus* HOOK.

Plentiful in the open pine forests and meadows of the Johnston Ranch, altitude 4500 ft. (No. 2185.)

Layia platyglossa *Gray.* Tidy Tips. *Blepharipappus platyglosus* GREENE, Pitt. ii. 246 (1892).

With the last. (Nos. 2023, 2041.)

Lessingia glandulifera *Gray.*

Common in the lower part of the pine belt, flowering in autumn. (No. 2626.)

Madia dissitiflora *T. & G.*

Barely reaching our limits in the cañons of the west side. (No. 2040.)

Madia tenella *Greene*, Pitt. iii. 167 (1897).

This species occurs sparingly in the lower part of the pine belt of the south and west sides. (Nos. 2268, 2662.)

Malacothrix Californica *DC.*

Sandy soil of Thomas Valley. (2182.)

Malacothrix Clevelandi *Gray.*

This enters our limits from the chaparral belt to the south. It is common beneath the Coulter Pines near Chalk Hill. (No. 2087.)

Microseris linearifolius (*DC.*) *Gray.*

Valleys and meadows of the south side below the 4500-foot contour. (Nos. 2024, 2086.)

Pentachæta aurea *Nutt.*

Not seen except on the south side, but there it is abundant, both in the meadows and beneath the pines, from 4000 to 6000 ft. alt. Where it is exposed the stems are either simple or branched from the base and only a few inches high; in the shade it is sometimes two feet or more high and branched above, the lower leaves fully two inches long. (Nos. 1124, 1136, 2057.)

Rafinesquia Californica *Nutt.*

Thomas Valley, at 4500 ft. alt.

Senecio triangularis *Hook.*

This Senecio reaches the southern limit of its range on San Jacinto Mt., where it occurs only along the creeks that flow

down the north side, and again in the hillside bogs near Deer Springs. These stations have an altitude of 7500–9000 ft. and are along the borderline between the Transition and Canadian zones. The species grows in similar localities in the San Bernardino Mts., but no other stations have been reported for Southern California. (Nos. 2535, 2571.)

Solidago Californica *Nutt.* Golden Rod.

Common over the higher slopes, running down to 5000 ft. alt. along Snow Creek. (Nos. 342, 827.)

Sonchus oleraceus *L.* Common Sow-Thistle.

Along streams in Strawberry Valley, etc. (No. 2294.)

Stephanomeria virgata *Benth.* *S. paniculata* NUTT.

Plentiful in the lower part of the pine belt. (Nos. 2587, 2631.)

Troximon heterophyllum *(Nutt.) Greene*, Bull. Torr. Club. x. 88 (1883). *Macrorhynchus heterophyllus* NUTT., Trans. Am. Philos. Soc. vii. 430 (1841). *Agoseris heterophylla* GREENE, Pitt. ii. 178 (1891).

Collected in the meadows of Thomas and Shingle valleys and along Squirrel Creek, all within the pine belt of the south and west sides. (No. 2038.)

Troximon retrorsum (*Benth.*) *Gray.* *Agoseris retrorsa* GREENE, Pitt. ii. 178 (1891).

Occasional throughout the lower part of the pine belt.

Wyethia coriacea *Gray.*

On low hills in Thomas Valley. (No. 2170.)

These specimens are quite depauperate as compared with the usual form: some are almost acaulescent, the small heads rising from the bases of radical leaves, the latter only 4–5 inches long, often truncate at the broad base; pappus variously cleft, the lobes sometimes awn-like, sometimes broad and fimbriate. There are, however, no constant characters on which to separate this form from the type.

INDEX.

M. K.

ERRATA.

Page 15, line 12, for *Philadelphus microphyllus*, read *Philadelphus serpyllifolius*.

Page 27, line 3, for *Amorpha hispidula*, read *Amorpha Californica*.

Page 33, line 35, for *Castanea chrysophylla*, read *Castanea sempervirens*.

Page 84, line 18, add as synonym of *Ribes lacustre molle* Gray, *R. montigenum* McClatchie, Erythea v. 38 (1897).

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TWO NEW ASCOMYCETOUS FUNGI PARASITIC ON MARINE ALGÆ.*

BY

MINNIE REED.

CONTENTS.

INTRODUCTION.

The association of fungi with marine algæ either in a symbiotic or a strictly parasitic relation is not common, as thus far but comparatively few cases have been reported. For some unexplained reason fungi seem to prefer to be associated with fresh water algæ, so that nearly all lichen-gonidia are fresh water species.

*Presented in partial fulfillment of the requirements for the degree of M.S., University of California, December, 1899. Prepared under the direction of Professor W. A. Setchell.

It is because of this fact that the two marine species just discovered on the Pacific Coast of North America (an Ulva-composite collected on the Bay of San Francisco, and a Prasiola-composite collected on the coast of Alaska), are especially noteworthy.

THE ULVA-COMPOSITE.

The Ulva-composite is a deep green when young but a dark olive to almost black when old. When dried it becomes a dull dark olive, the older plants always being the darker. The stipe and basal portions of the frond are always of a lighter color, and often almost a translucent greenish tan.

The fronds vary greatly in shape, from narrow lanceolate to oblanceolate or even sometimes to oval, but the broad lanceolate is typical. The frond narrows gradually into a short slender stipe growing from a disk-like hold fast. Occasionally a specimen is found in which all the fronds arise from the tip of a single slender stipe. The old fronds are very seldom regular in outline, as the tips and edges have been torn, broken, or contracted and distorted in various ways. Occasionally specimens are collected which send out small fronds and bud-like projections from the edges and surfaces of the main frond, giving it a very shaggy or ragged appearance.

There is a very great variation in the size as well as in the shape of different fronds as they measure from 1 to 2.5 cm. in length and 1 to 50 mm. in width. The average plant is about 1.5 cm. high. The typical plant has one frond always much larger than the others; and all diminishing until the smallest is scarcely visible. (Cf. Fig. 1, Pl. 15.)

The surfaces are much roughened by the perithecia, which are dark brown or black wart-like eruptions scattered irregularly over the frond from near the base to the tip. The perithecia vary in shape and size, but are usually hemispherical with a concave lighter colored apex, and are scattered over both surfaces of the frond. The surfaces of the frond are also usually corrugated or wrinkled and warped, as if stretched in some parts and contracted unequally in others. Often one or both edges of the

frond are drawn in, leaving the center to bulge out, or the opposite edges to curl.

When fresh the fronds are thick and cartilaginous, but when dry they are leathery. The thickest portions are the stipe and the basal part of the frond. It becomes thinner towards the tip and edges and where no perithecia have developed. The base and stipe are from 150–200 μ thick, while the thinner portions are only 70–100 μ.

A section shows five distinct layers in the frond. First the gelatinous envelopes (one for each surface) of medium thickness, into which project the tips of the lateral mycelial filaments which branch from the medullary layers. The tips stand up close together between the green cells, perpendicular to the surface like the pile of velvet. Only the lateral filaments lie next the cell walls forming a close network about them, but never penetrate within. The tips are always thickened and club-shaped, but are more angular and more deeply pigmented around the perithecia and isolated cell groups, and also on the edges of the frond. They have exceedingly thick walls with small lumen, and sometimes the walls appear to be stratified. (Cf. Fig. 2, Pl. 15.) The diameter of lateral hyphæ is 1–5 μ.

Just inside each outer layer is an "algal" layer of green cells as in ordinary Ulva. Every cell or group of cells is enclosed in a capsule formed of a network of lateral mycelial threads with gelatinous matrix between. First a single cell is enclosed and then this divides, grows, and divides again until the resultant cells form isolated groups of diads, tetrads or octads in the same capsule, which must be gradually expanded by the pressure within the surrounding mycelial tips either making them angular or flattening them somewhat. (Cf. Fig. 3, Pl. 15.)

These groups of isolated cells are most numerous around the perithecia and on old plants much distorted by many perithecia. Often these cell-groups are pushed outwards from the edge or surface of the frond like buds, or gemmules. This is best seen in the cross section, where they stand out more or less distinctly from the cellular layer, and may be analogous to soredia, as Reinsch (Zur Meeres Algen von Süd-Georgien, p. 426–427, 1890) has suggested in the case of his Dermatomeris. It seems from

the cross section that the adventitious frondules, arising from the surface or edge of the frond, develop from these groups of isolated cells. It may be that these fronds break off occasionally and form new individuals, as their attachment is very slight. The cell groups are doubtless forced outwards by their own rapid growth and division, which is usually in the planes at right angles to the surface and by the outward pressure of the growing hyphæ in the medulla and cortex immediately surrounding the capsule.

The algal cells are 6–13 μ high and 4–5 μ wide. They are from oblong to oval in shape, with the longest diameter at right angles to the surface of the frond, so that the two cell layers appear much like the palisade cells of the higher plants. In the superficial view the cells seem scattered about without any special order, and they appear almost quadrangular with medium spaces between them.

The medulla is about one-third the entire thickness of the frond, that is, 20–50 μ thick. It is composed of innumerable fine mycelial filaments interwoven closely in all directions, though the majority are parallel to the surfaces. A gelatinous coat surrounds each filament and these coats coalesce, filling in all the interspaces. The filaments are cylindrical, hyaline and much finer than those projecting into the cortex, being scarcely 1 μ in diameter. The walls are thick and the contents granular.

The perithecia appear on the surface of the frond as blackish spherical swellings. They measure in superficial diameter 364–520 μ and are usually spherical and mammillate, but are sometimes flattened oval. Each perithecium consists of a large rounded cavity of about the diameter of the normal frond, surrounded by a thick wall. In the cross section (Cf. Fig. 3, Pl. 15) the wall is seen to be deeply pigmented about the ostiole, and also on the side of the cavity opposite the ostiole, that is, the basal wall. The cavity is lined by a colorless thin pseudoparenchymatous layer, from which the club-shaped asci originate, and project towards the center. The surface of the perithecium is the outer cortical layer of the frond which is somewhat modified by the growth and expansion of the interior tissues. The algal layer is also considerably modified. There are numerous

scattered groups of algal cells, also single algal cells somewhat smaller than normal, often flattened and always separated by deeply pigmented mycelial branches. Just below the algal cell is a dense pseudoparenchyma also deeply pigmented, while beneath this is a thick layer of colorless parenchyma which completely surrounds the cavity on all sides. Within this is the innermost lining of the perithecial cavity, a thin walled protoplasmic subhymenial layer from which the asci develop. The transition from the mycelial filaments to the pseudoparenchyma layer is almost imperceptible. The mass of mycelial threads in the medulla appear as if they had been divided in the center and pressed outwards to form the sides, where they have fused and interwoven in forming the walls about the asci. On the sides of the perithecium the medullary filaments are again intertwined and follow their normal course until again interrupted by the development of another perithecium. The perithecium projects on both surfaces of the frond, but projects farthest on the ostiole or apical side. The ostiole gradually develops after the perithecium begins to mature, and probably is formed by a dissolution of the perithecial walls after their formation, and near the time of the maturity of the spores. There is a small canal from the inner cavity to the outer opening or ostiole. This is lined and surrounded at the inner opening by fine, colorless hairs. The ostioles are on either surface of the frond, as some perithecia open on one side and some on the other.

The inner wall of the perithecium consists of one layer of cells, flattened tangentially, thin walled and protoplasmic. This is the subhymenial layer from which the asci are developed. The layer next to this is five or six cells deep, has thin walls also flattened tangentially and often pointed at the ends. The outer layer of pseudoparenchyma has much larger, thicker walled cells, slightly or not at all flattened, pigmented very deeply for several cells in depth on the upper and lower surfaces, and slightly pigmented on the sides within the medulla. The pigmentation occasionally extends entirely around the perithecium and into the subhymenial layer. The pigmentation varies greatly even in the perithecia of the same frond, both in the thickness and regularity of the layer. This layer seems to be formed by the

coalescence and interweaving of the outer mycelial branches, and seems also to send out branches which radiate outwards to the surface of the frond, forming a network between the algal cells. At the upper surface of the perithecium, the mycelial filaments which project close around the ostiole are not so coarse or so deeply pigmented. This explains the pale color of the apex of the perithecium. Just outside this circle of pale hyphæ are the coarse, deeply pigmented, and densely packed mycelial tips which form a wider circle about the ostiole, and surround the isolated groups of algal cells, or single cells scattered about irregularly, and fill all the interspaces closely. From the ostiole itself, very fine hyaline hairs project outwards. The developing perithecia show, at first, a small lens-shaped collection of hyphæ rich in protoplasm in the center of the medulla. It soon becomes a complex mass with three to five radiating centers from which the protoplasmic ascogenous hyphæ develop and are to be distinguished by their deep staining. The central portions and perithecial walls take the stain less readily. Finally the central tissues disappear and a layer of protoplasmic cells is formed on the inside of the perithecial cavity, which later produces the asci. By the expansion of the central cavity and the elongation and increase of the medullary filaments, the outer lateral filaments are pressed outwards, bulging out the cortical layer with its algal cells, which are scattered and flattened in the process. During this period the mycelial threads of the medulla are pressed together, blended and interwoven, to form the pseudoparenchyma of the perithecial walls. Just how the hyphal tissue in the center is absorbed or spreads out to form the perithecial walls of delicate cells surrounding the cavity was not distinctly seen, but probably the fine hypha-like filaments radiating from the central placenta interweave, coalesce, and in some way grow to the perithecial wall as it is developing, and are spread out by their expansion and growth to form this thin subhymenial layer. No doubt the cavity within is greatly increased by the growth and expansion of the developing asci which crowd from all sides toward the center, filling it, forcing out the perithecial walls in every direction, and thus flattening tangentially the cells of the inner walls. Only the innermost layer contains granular protoplasm, which is shown by eosin or hæmatoxylin staining.

After the asci have formed, a dense fine hair-like hyaline growth develops about the ostiole and projects obliquely downwards into the perithecial cavity between the asci, lining the entire canal and ostiole.

The asci (Cf. Fig. 4, Pl. 15) when they first arise from the subhymenial layer appear like club-shaped projections from the perithecial wall. The protoplasm within is one mass at first, but it very soon divides to form the eight ascospores. As the ascospores grow the asci bulge and enlarge like small balloons, forming a distinct stalk, the eight oval spores showing very distinctly through the delicate thin walls of the ascus. There is an enormous number of asci in each perithecium and they are continually forming, as may be seen in the cross section, where they appear in all stages from those just budding to the ripe ascus with its eight spores. Hence, though the asci are continually ripening, the perithecia are always crowded with them and it may be this pressure which assists in bursting the walls of the asci, causing the escape of the ascospores out through the ostiole. The asci are 23–40 μ long by 10–13 μ wide.

The ascospores are hyaline, thick-walled, one-celled and 3.5–7 μ wide by 10–13 μ long. They vary somewhat both in size and shape, some being elliptical and others broadly oval. The spore contents are granular, with a broad irregular equatorial band of very refractive bodies, which appear like oil drops, yet do not give the ordinary reactions for oil (Cf. Fig. 5, Pl. 15). The outer part of this equatorial band lying next the wall is protoplasm which stains deeply with eosin or hæmatoxylin.

The spores are discharged in vast numbers, when the fresh fronds with ripe perithecia are placed upon moist glass slides. After a day the slides are covered with whitish dots, one under each perithecium. The spores are surrounded by a whitish gelatinous substance when ejected.

The freshly discharged spores germinate readily in a moist chamber, both in fresh and salt water. In three days they form long germ tubes, especially when only slightly moist. In germinating, the spore becomes swollen, the walls appear thinner, the bands of refractive bodies disappear or grow thinner, and the mycelium projects either from the end or the side adjacent to the

equatorial band (Cf. Fig. 6, Pl. 15). The protoplasm of the spore with the refractive bodies flows into the germinating tube, which grows very long after a few days, branches and becomes septate. After germinating the spores are 10–12 μ wide and 18 μ long. The young mycelium is 3–4 μ in diameter when 10–100 μ long. After the spore has been germinated several days, the mycelium begins to branch, and often forms either at the tip or back of the tip bulb-like swellings nearly as large as the spore itself. All along the mycelium the transverse septa occur at frequent intervals and are very distinct.

The Ulva-composite grows just about the upper tide mark on the shady side of the sandstone boulders at the entrance of the Bay of San Francisco. It was first collected at Lands End by Prof. W. A. Setchell in October, 1898. It has since been collected at Fort Point, and probably occurs all along that shore from Lands End to the Fort. It always seeks the shade and some protection from the full force of the waves, and occurs in patches of various sizes from a few inches to several square feet in extent. It has been collected every month in the year and always with perithecia.

It is always associated with a small Ulva, probably *U. Californica* Wille, and almost as frequently with *Enteromorpha minima*. Sometimes a patch is almost entirely composed of the composite plants, and again, with almost all either Ulva or Enteromorpha and but a few composite plants. Probably it is either this Ulva or this Enteromorpha which forms the algal portion of the composite plant. The general shape and size of the fronds and hold-fast of the composite suggests *Enteromorpha Linza*, but in the cross section there is a very decided difference. The cells of the Enteromorpha are much smaller, closer, and more quadrangular, while the long axis is parallel to the surface instead of at right angles, as in the composite plant. There is no *E. Linza* associated with the composite or on that shore; so probably that is not the algal part of the composite, as the presence of the fungus could hardly explain such a wide difference in the cells.

The composite also has a general superficial resemblance to *Enteromorpha minima*, but a cross section shows a wide difference in structure, especially in size and shape of the cells. This

difference is so great that it is not at all probable that it is the algal associate in the composite plant.

Tne Ulva, however, which always grows with the composite is somewhat different in general appearance. It has smaller, broader, and thinner fronds, and is a much lighter green than the composite. The cross sections, however, resemble each other in almost every detail. The size, shape, and arrangement of the cells, and the thickness of the outer gelatinous layer are about the same. The thickness at the base of the frond is 67–100 μ, and the upper part of the frond 33–60 μ, while the cells are 10–13 μ long and 5.5–7 μ wide. All these measurements correspond quite satisfactorily with the composite plant. The base and stipe of the two fronds are quite different. The composite has a slender stipe gradually widening into the base of the frond, and is brownish to hyaline, with but few small algal cells, which seldom ever elongate into tubes growing down towards the hold-fast. The Ulva, however, has but little or no stipe, as the frond spreads abruptly from the base into a broad oval. The character of the cells near the base is entirely different, as they become much larger, while the lower cells form long tubes which descend into the hold-fast. Yet these differences might be due to the association of the fungus in the composite plant; so that it seems that there is very little doubt that this associate Ulva is the algal part of the composite plant. There is also little doubt that this Ulva is *U. Californica* Wille, as it resembles the authentic specimens published in Phycotheca Boreali-Americana, No. 611. The cells of *U. Californica* Wille, are more quadrangular and slightly thinner and smaller, and have less gelatin outside, but these slight differences might be easily explained by the different localities in which they were collected, or the method of preservation and time of collecting. Wille's specimens were collected at San Diego, but the species is probably common all along the California coast, and like most plants doubtless varies somewhat with the locality.

The algal portion cannot be *Enteromorpha Linza* or *E. minima* because of their very different structure; nor can it be *Ulva Lactuca* L. or *U. fasciata* Delile, because of the very great difference in size, habit, and general structure. We can there-

fore conclude from all evidence obtainable that the algal portion of the composite is *Ulva Californica* Wille. Thus far no material has been examined that is not completely penetrated by the mycelium, and bearing perithecia. This fact makes it seem probable that the fungus spores germinate and enter the tissues of the young Ulva when it is first germinating from the spore and they continue their development together, either in a symbiotic or parasitic relation. In this way all the tissues of the Ulva are entirely penetrated by the fungus, and therefore we find no mature Ulvas with the mycelium just penetrating.

The fungus forming this composite with the Ulva is quite certainly a Guignardia of some kind, as it resembles *Guignardia Prasiolæ* (Winter)* in habit, development, and general structure. It is probably a new species, as its spores differ from that species both in shape and size, and likewise the asci and perithecia. It is associated with the Ulva very much as Reinsch's fungus in Dermatomeris and is similar in habit, but the spores are quite different.

The spores are oval, with thick walls and 10–13 μ by 3.5–7 μ, while the asci are 23–40 μ by 10–13 μ. The perithecium measures 364–509 μ on the outside diameter and 120–270 μ on the internal diameter. *Guignardia Prasiolæ* (Winter) has spores 12–15 μ by 3.5–4.5 μ, and asci 53–57 μ long by 9 μ wide. The perithecium is 200–220 μ wide. The spores are decidedly longer, narrower, and more pointed than those in the Ulva. The spores of Reinsch's *Dermatomeris Georgica* are 5.5 μ by 2.5–2.8 μ, and asci 33–47 μ by 5.5–7 μ. "Sporocarp 130 μ internal and 148 μ external diameter." From the above comparison it is conclusive that our fungus is a different species of Guignardia, and perhaps it may be named *Guignardia Ulvæ*, as most fitting and suggestive, because of its association with that alga.

* *Læstadia Prasiolæ* Winter. The species must be transferred to Guignardia, since the name Læstadia is preoccupied by a genus of Compositæ.

THE PRASIOLA-COMPOSITE.

The second algal-composite, when fresh and moist, is a dull olive-green, but becomes brownish to leaden olive when dry. The older plants are always the darker.

The fronds are very much broader than long, much curled and crinkled, and often the edges are involute until they meet, so that each frond seems like a little sack. Each plant has three or four fronds arising from a single very short stipe at the center, or separate stipes from a small central hold-fast. The plant is 2–4 cm. across, while the fronds are from 2–4 cm. wide and 1–2 cm. in length. (Cf. Fig. 7, Pl. 15.)

The fronds are soft, flabby, and easily torn when moist, but become brittle and coriaceous or leathery when dried, especially when old and covered with perithecia. The greater part of the surface of the frond is roughened by the brownish hemispherical elevations of various sizes, 180–454 μ in diameter by 90–175 μ high. They are scattered over both surfaces irregularly from near the base to the apex of the frond. The cells viewed from the surface are grouped in tetrads, much as in the ordinary Prasiola, and the tetrads are arranged in quadrate or polygonal areas, with distinct hyaline spaces between. In the young fronds, having but little or no fungus in the tissues, the tetrads are very regular and the interspaces perfectly hyaline, (Cf. Fig. 13, Pl. 16) but in older fronds, completely occupied by the fungus, the interspaces are no longer hyaline but closely packed with pigmented tips of the hyphæ. These tips stand up perpendicular to the surface like pile on velvet, and are sometimes between the cells forming the tetrads, as well as the areas between the tetrads. It is these tips which darken the fronds and increase their thickness and toughness. The surface measure of the cells varies from 4 to 10 μ in different fronds.

In the cross section the outermost gelatinous layer of the frond sometimes shows a slight stratification, especially in the old plants having many perithecia. The outer layer is also denser and the hyphæ do not penetrate through it to its surface. Beneath this layer the hyphæ are abundant and evenly distributed in the older specimens, but very much more scattered

and less abundant in the younger plants. Sections were made of fronds in all stages of combination, from those without any or very few hyphal threads, to those completely penetrated with a closely interwoven mycelium. (Cf. Figs. 8–12, Pl. 16.)

The young fronds, scarcely infected with the fungi, are monostromatic, but the older composites are from eight to sixteen cells thick. This gradual increase in the number of cells and consequently of the thickness of the fronds is shown in the series of sections represented in figures 8 to 12 on plate 16. Soon after the fungus takes possession of the frond, the cells begin to show the same tetrad arrangement in the cross section as seen from the surface, there being one, two, three or four tetrads in the cross section of the oldest fronds. Each tetrad is closely surrounded by the interwoven mycelium which forms a kind of capsule. In the monostromatic stage the cells are oblong to oval or elliptical and often columnar like the palisade cells of the higher plants. After the first division, which is always transverse to the cell, the cells become quadrangular and always remain so in the later stages. The tetrads are less regular in shape, size, and arrangement near the perithecia, and often are separate or broken up into two or even into single cells more or less flattened. In the early monostromatic stage the cells are 11–14 μ in vertical diameter and 3–9 μ in horizontal diameter; while in the later mature stage of the composite the cells are 5–11 μ square. The immature or monostromatic fronds are 16–45 μ thick, while the mature fronds are 75–146 μ thick.

The hyphæ which invest the algal cells, and are interwoven in all directions around the tetrads are very coarse, somewhat angular, with very thick walls and small lumen. They vary from 1.5 to 3 μ in diameter at the tips. The inner hyphæ are finer, about 1 μ in diameter and colorless, but the lateral branches, projecting out into the cortex, are slightly enlarged, becoming club shaped and also slightly pigmented, especially at the extreme tips around the perithecia and on the surface of the frond. They stand out vertically, embedded just beneath the outermost gelatinous layer. The hyphæ do not enter the algal cells, but simply lie close to their walls completely surrounding them, forming a sort of capsule about each tetrad when the frond is mature.

The penetration of the fungus mycelium into the frond and its contact with the algal cells, seem to act as an irritant or stimulant upon the cells, and cause them to divide in a plane at right angles to the usual division. In this way the frond becomes distromatic or polystromatic. As the mycelial threads increase in number, and the cells are more fully invested and isolated from each other, this division continues until each half has divided two or three times and "tetrads" are finally formed. After the final division the "tetrads" are completely inclosed in their capsules of interlaced mycelial threads.

The perithecia are scattered irregularly over the surface of the frond from the base to the apex and vary both in size and shape. They are usually hemispherical or sometimes slightly mammillate and brown to black when mature. The external diameter of the perithecia varies from 273–450 μ, and the internal diameter from 110–216 μ. In the cross section (cf. Fig. 14, Pl. 16) the perithecium lies in the center half-way between the upper and lower surfaces of the frond where there are but few scattered algal cells. At the sides of the perithecium the tetrads have been pressed together and broken up by the growth and expansion of the central nucleus, and the final development of the perithecial wall. The scattered cells on the upper and lower surfaces of the perithecium are flattened slightly and their tetrad arrangement completely destroyed by the expansion of the perithecium. The perithecial walls are of medium thickness and are pigmented on the upper part about the ostiole and also at the base opposite. The inner, subhymenial layer is full of protoplasm and thin walled and is pseudoparenchyma, not well defined. This gradually changes to well defined thick-walled pseudoparenchyma as it passes outward toward the exterior, the thickest walls and deepest pigmentation being toward the outer surfaces, there being little or no pigmentation at the sides of the perithecium. The thick-walled pseudoparenchyma gradually shades into the interwoven mycelia about the outer perithecial wall, and the mycelial branches project outward from its surface into the cortex or joins with the medullary threads at the sides continuing the center of the frond until interrupted by another perithecium.

The perithecium first arises from a mass of hyphæ rich in

protoplasm in the center of the frond. This expands and is exposed in a dense growth of interwoven hyphæ which, as the perithecium increases in size, seem to fuse more or less to form the pseudoparenchyma wall while the upper and lower walls become pigmented. While the perithecial wall is forming the central mass of protoplasm seems to become constricted into several lobes, then a space appears, and finally a rounded cavity with a lining of protoplasmic thin-walled cells or closely interwoven mycelial threads, from which the asci are developed later. It is during this expansion of the perithecium that the walls of the frond are rounded outwards, and the algal cells are flattened and rearranged.

The ostiole is rather small, and very probably is developed by a resorption of the perithecial walls in that region, as there is no indication of either the ostiole or canal in the young immature perithecium. The ostiole is surrounded by a dense growth of slender colorless hyphæ which extend into the canal and project into the cavity of the perithecium. The asci develop from the entire inner wall of the perithecium, and from the subhymenial layer, and project into the central cavity. They develop successively, so are found in all stages from the tiny hypha-like projections to the mature ascus with the ripe ascospores. The mature asci are long club-shaped stalked bodies 23–40 μ long by 7–14 μ wide, and contain eight ascospores. The spores are long and narrow with pointed ends, and walls of medium thickness. The spores when stained show a broad equatorial band of protoplasm, within which are numerous granules and oil drops. The spores have thin walls, are hyaline and measure from 8.5–13.5 μ in length and 3–4 μ in width. When discharged the spores are inclosed in a mucilaginous covering, which causes them to adhere rather closely together in masses.

The Prasiola-composite described above was collected by Prof. W. A. Setchell, in the summer of 1899, in two widely separated localities in Alaska. It was found in great abundance, growing on the rocks near the tide line on the coasts of Unalaska and Kadiak Islands. A Prasiola free from the fungus, and undoubtedly the same species as in the composite, was found on the same rocks.

There is not the least doubt that the algal portion of this Alaskan composite is a Prasiola, but of just what species it is rather difficult to determine as I have access to but few authentic specimens, and most of the descriptions and figures are inadequate and unsatisfactory. Both the habit of the composite and its association with the fungus suggest *Mastodia tessellata* Hooker, but Hooker's figures appear to be diagrammatic, while his description does not agree with our Alaskan specimen. Hariot, however, collected the same "*Prasiola tessellata*" on the Island of Terra Del Fuego, and carefully describes it in his article on the algæ of the "Mission Scientifique du Cap Horn's" (1882–83). He carefully describes and figures the microscopic structure, and compares his material with Hooker's specimens, finding them to be identical, though his specimens were marine and Hooker's were fresh water. Hariot discovered the composite nature of the Mastodia, which Hooker never suspected, and decided that it was *Prasiola tessellata* associated with an ascomycetous fungus, *Læstadia Prasiolæ* Winter. Since Hooker's first publication of *Mastodia tessellata* in the Journal of Botany (1845) it has been republished, figured, and described by several botanists, yet Hariot is the only one who really makes the nature of the composite clear. In 1849, Kützing referred *Mastodia tessellata* Hook. to the genus Prasiola. He gives a figure in Tabulæ Phycologicæ (Cf. Vol. 5, Pl. 40), which, according to Hariot, resembles the plant described by Hooker and Harvey. Rabenhorst in 1868 (Fl. Europ. Alg. III, p. 311) reproduces Kützing's figures and descriptions, but does not mention the conceptacles which characterize it, or make any comment upon the nature of the plant. J. G. Agardh also discusses the "*Ulva tessellata*" of Hooker and Harvey, and the *Prasiola tessellata* of Kützing, and decides that they are synonymous; but at the same time he considers Mastodia to be a distinct genus. Bornet likewise studied Hooker's Mastodia and decided that it was a composite consisting of a Prasiola and an ascomycetous fungus. With all these discussions of the *Mastodia* and *Prasiola tessellata*, there is no description of the Prasiola any better than Hooker's: hence the difficulty of comparing the Prasiola of the Alaskan composite. The Alaskan

Prasiola differs from Hooker's *Prasiola tessellata* in the shape and color of the fronds and in the arrangements of the tetrads and areoles. There is not that distinct tessellate arrangement of the tetrads, but the areoles are polygonal or imperfectly quadrate.

This Alaskan Prasiola, as seen from the surface, resembles none of the authentic specimens available for comparison, except *Prasiola furfuracea* (Mert.) Menegh, collected in Sweden by Nordstedt. The cells of this specimen are smaller and the cells and tetrads and hyaline spaces are not so distinct. The cross sections resemble one another, but *P. furfuracea* is thinner than the Alaskan specimen. The frond of *P. furfuracea* is 20–23 μ thick, and the cells 10–13 μ vertical diameter and 4–6 μ horizontally. The fronds of the Alaskan Prasiola are 16–45 μ thick and cells 11–14 μ vertically and 4–9 μ horizontally. Another specimen of *Prasiola furfuracea*, collected by H. Heiden at Mecklenburg, Germany, and published in Phykotheka Universalis Fasc. IX No. 438, is quite different from both the Nordstedt specimen and our Alaskan Prasiola. In Heiden's specimen the tetrad areas are arranged between lines radiating from the base of the frond, but near the outer edge the areas are like those in Norstedt's specimen. The cells and the plants are very much smaller, while the fronds are stipitate instead of sessile as in Nordstedt's specimen. If both these specimens are correctly determined this species must vary greatly; yet even then it could scarcely be considered the same species as the Alaskan Prasiola. There is even a wider difference between our Prasiola and *P. crispa* (Lightf.) Ag., both in the surface view and in the cross section. The cells of *P. crispa* are larger, coarser, and stand out more prominently on the surface, while the areas are rather rectangular and very distinctly separated by a hyaline space. The fronds are very thin and flabby and are very broadly reniform with ruffled edges.

Our Prasiola does not agree with any Prasiola described in De Toni's Sylloge Algarum, so is probably a new species. It seems wise then to give this Prasiola a provisional specific name until more is known about this genus and the species have been carefully revised after a thorough study. In the meantime we suggest the name *P. borealis* as a good name, indicating its

northern habitat. The description will be given later in the paper.

The fungus associated with the *Prasiola borealis* is probably a different species from that collected by Hooker and Hariot, as there is considerable difference in the measurements of both the asci and ascospores. The Alaskan species has spores 8.5–13.5 μ by 3–4 μ and asci 25–33 μ by 7–14 μ, while the spores of Hariot's species, according to Winter, measure 12–15 μ by 3.5–4-5 μ, and the asci 53–57 μ by 9 or 10 μ. The spores of the Alaskan species are shorter and thicker in proportion than those of *Guignardia Prasiolæ* (Winter), so that both tne shape and size differ from Winter's species. It may be appropriately named *Guignardia Alaskana*, and will be described later.

RELATION OF THE FUNGUS TO THE ALGA.

Upon a careful examination of the Ulva-composite, the idea of a symbiotic relation between the alga and fungus, similar to that of the ordinary lichen, is suggested. The outer gelatinous layer with the erect hyphal filaments embedded in it, the layer of green algal cells beneath, which are separated from one another by these upright filaments, and in the center the medullary layer of compactly woven filaments surrounded by gelatin which completely separates the algal cells of the upper and lower surfaces of the frond, all suggest very strongly the lichen structures, while the perithecia, scattered irregularly over the surfaces of the road. and opening on either surface, together with the structure of the perithecia, especially the parenchymatous layer and its pigmentation, are also very much like certain ascomycetous lichens with heteromerous thalli.

In texture and general superficial appearance, the fronds are also very similar to some lichens. The bud-like projections of the isolated cell groups which form small adventitious fronds, or possibly soredia, are likewise characteristic of lichens.

On the other hand, the plant retains the general Ulva form and structure, having the usual holdfast, stipe and ordinary shaped fronds with the two layers of cells of nearly normal

shape, size and interspaces, and also an outer gelatinous envelope of about the ordinary thickness.

Of course there are some alterations in the form and structure of the alga; but this always occurs where a parasite takes complete possession of its host and penetrates all its tissues. Under such conditions the alga could not develop normally in every detail. Consequently there is a general thickening of the frond, a deeper coloration, a greater irregularity in shape and surface of frond, with leathery texture, and also less regular and narrower cells.

All these changes would naturally result from the growth and development of the mycelium between the cells and in the medulla. The development of the perithecia completes the abnormal growth and change in the form of the frond, by causing the numerous swellings and openings into the medulla. Perhaps instead of being a symbiotic relation, where each is benefited, it may be a case of extreme parasitism, where the ascomycete is the aggressor and receives all the benefit at the expense of the alga. In none of the material examined has any alga been found fruiting or showing any signs of fruit. Probably it has not vitality enough to support the fungus and also fruit. Yet the plant continues comparatively abundant and persistsnt throughout the year. The ascomycete on the contrary continues producing ascospores throughout the year with undiminished vigor and abundance. The fungus is evidently favorably situated for growth and reproduction.

It may be after all that the relation of these two plants is symbiotic, and they may be mutually benefited by the union, though there is no doubt that the fungus receives the most, because it cannot exist without a chlorophyllose plant to produce its food, while the alga is able to get its nourishment directly from inorganic material. It furnishes not only food but also protection to the ascomycete. Possibly the mycelium of the ascomycete toughens and holds the frond together so that it can better resist wind and weather. It is certainly much tougher and better able to resist the waves than an ordinary Ulva.

In the Prasiola-composite the relation of the fungus to the Prasiola is probably much the same as that of the Ulva, though

the transformation of the Prasiola is much more striking, and the structure more closely approaches that of the ordinary lichen. Here the relation seems much more like that of a lichen fungus to its gonidial alga, than of an ordinary parasite. The fronds of the Prasiola-composite are entirely different from the normal Prasiola in structure, as well as in general appearance. The peculiar manner in which the cells divide in three planes and form "tetrads," thus enormously thickening the frond, certainly suggests the lichen formation. The fact that the "tetrads" are so entirely isolated and so widely scattered also suggests the distribution of lichen gonidia in the thallus. Likewise the density of the interwoven mycelium and the pigmentation of the outer layer with the numerous irregularly scattered perithecia, still further establishes the belief that it is a lichen. It seems very probable that this Prasiola is the gonidia of a lichen fungus, which surrounds it and associates with it very much in the same way as in Reinsch's Dermatomeris and Hooker's Mastodia. The Prasiola-composite resembles both the Mastodia and Dermatomeris in several important details; as the isolated "tetrads," the perithecia, and the dense mycelium separating these cells forming the "tetrads," as well as the general habit of the plant. Indeed they are so much alike in both structure and habit, that if Reinsch is correct in his classification of Dermatomeris, this Prasiola-composite should be classed with them as an endocarpous lichen. The Mastodia, which is also a Prasiola-composite, is a fresh water species and differs in several details of structure, if Hooker's figures are correct. They are much alike in surface view, but in cross section Hooker's figures show only a single layer of algal cells. The interweaving mycelium does not show, but only the perithecia, while Hariot's figures show all these details and resemble ours quite closely. Perhaps the Ulva composite should also be classed in this same group, though it is much less distorted and transformed by the fungus than the Prasiola, and resembles a lichen much less, both in external appearance and structure. Yet in spite of these differences these four composites are undoubtedly closely related and seem to approach the true lichen structure. It seems best, however, in view of the later ideas concerning lichens, to describe them simply as composites of merely parasitic relationship.

GEOGRAPHIC DISTRIBUTION.

It is a rather interesting fact that the first specimens of such marine composites should have been collected in the Antarctic regions and the last near the Arctic regions, though not within the Arctic Circle. It is also noteworthy that two composites have algæ in the same genus and all have fungi of the same genus, so that they are very closely related in spite of the fact that they come from opposite hemispheres. The Alaskan species, in all probability, is widely distributed along the Northern Pacific shores, and may extend into the Arctic region. The Ulva-composite, thus far collected only in San Francisco Bay, may extend up and down the coast some distance.

DESCRIPTIONS.

Prasiola borealis, sp. nov.

Fronds broad concave cuneate to broadly obovate, with a stipe, or sessile, margins crenulate, crispate, or entire, bright green, thin to medium, flabby and membranaceous; plants suberect 0.5–1 cm. high, forming a small rosette of three or four fronds from a small hold-fast. Cells in surface view quadrate medium size, arranged in distinct tetrads with a well marked space. The tetrads are disposed in quadrate or polygonal areas, with wide spaces between them. Cells in cross section oblong to oval or columnar, close together with a thick gelatinous cortex on both surfaces. The cells are 11–14 μ vertical diameter and 4–9 μ horizontal. The frond is 33–45 μ thick.

Guignardia Ulvæ sp. nov.

Perithecia numerous scattered irregularly over fronds, large, conspicuous, dark brown to black, spherical, immersed in the thallus of *Ulva Californica* Wille, but prominent on both surfaces, 364–509 μ in diameter, vertex convex, pore simple, pale to hyaline, opening on either side of the frond. Asci balloon shaped, stalked, with eight spores, 53–57 μ long, 9 μ wide. Spores oblong to oval, thick walled with granular or oily contents, hyaline, 10–13 μ long by 3.5–7 μ wide.

Guignardia Alaskana sp. nov.

Perithecia dark brown or blackish, numerous, scattered irregularly, large, spherical, immersed in the thalli of *Prasiola borealis*. projecting on both surfaces, 273–450 μ in diameter, vertex convex, pore simple, opening on either surface of the frond. Asci club-shaped with long stalks, eight spored, 25–33 μ long and 7–14 μ wide. Spores narrowly elliptical, with pointed ends, with medium thin walls, hyaline: 8.5–13.5 μ long, 3–4 μ wide.

METHODS.

For the coarser anatomy and general structure, ordinary razor sections were used, but for the more minute study of the mycelium and perithecial walls it was necessary to embed and section with the microtome.

I fixed my material, after soaking in sea water, by boiling in a saturated solution of corrosive sublimate a moment, then running up from 50 per cent. into 100 per cent. alcohol, passing through bergamot oil and into paraffine. The sections were 2–6 μ thick.

A water solution of eosin proved excellent for bringing out the mycelium and the perithecium with its contents. The protoplasm in the mycelial threads, and in asci or ascospores stained deeply, leaving the cell walls and mycelial walls in distinct contrast.

The best stain for the finest detail study is the iron hæmatoxylin which brings out the mycelia and pseudoparenchyma of the perithecium very distinctly.

Thionin, anilin blue and Congo red were also used for stains, but they were not very satisfactory.

PLATE 15.

Ulva-composite.

1.—Typical group of plants of *Ulva Californica* Wille, infested with *Guignardia Ulvae* Reed. (nat. size.)

2.—Portion of surface view, showing "capsules" of cells of the Ulva surrounded by the tips of the peripheral pigmented hyphæ. (B. & L., oc, 2, obj. 1/12.)

3.—Cross section through the center of a perithecium. (B. & L. oc. 2, obj. 1/2.)

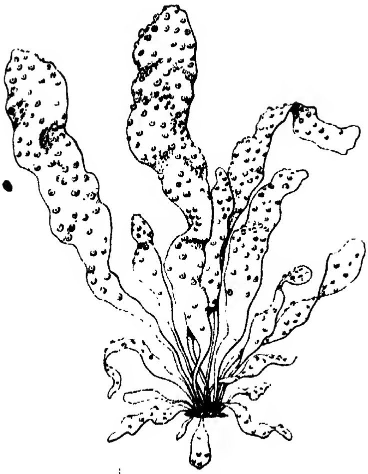
4.—Three asci from a perithecium. (B. and L. oc. 2, obj. 1/12).

5.—Seven spores, ejected from a perithecium. (B. & L., oc. 2, obj. 1/12.)

6.—Spores germinating in water. (B. & L. oc. 2, obj. 1/12.)

Prasiola-composite.

7.—Typical group of plants of *Prasiola borealis* Reed, infested by *Guignardia Alaskana* Reed. (nat. size.)



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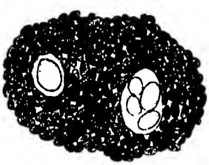

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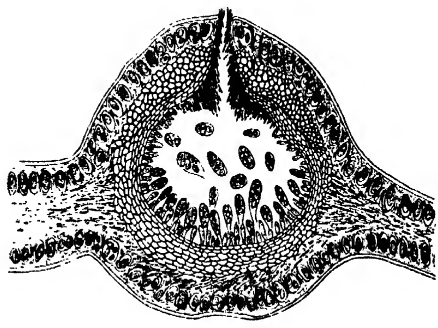

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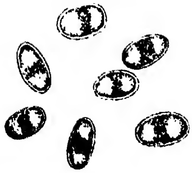

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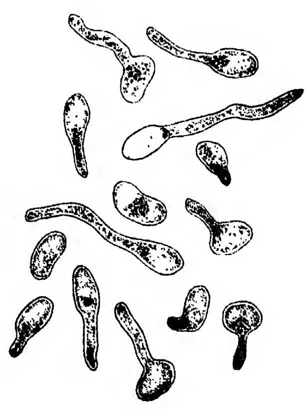

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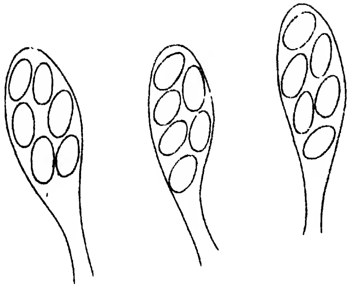

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ALGÆ OF NORTHWESTERN AMERICA

BY

WILLIAM ALBERT SETCHELL

AND

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CONTENTS.

ALGÆ OF NORTHWESTERN AMERICA.

INTRODUCTION.

No account of any completeness, or of pretension towards completeness, of the algæ of the northwestern coast of North America has ever been published. Various accounts have been written and odd references have been made in general and special works, but nothing which has brought together all the available materials. We have been at work for some time trying to obtain such a knowledge as to warrant the attempt, and in the following pages we shall try to bring together all that is known to us, either from specimens or from the literature, of the algæ of the region known as the Northwest Coast. Unfortunately, the specimens from which the earlier accounts are drawn, are all preserved, as many as still survive, in various European herbaria and are, as yet, inaccessible to us. We have tried, however, to make full use of such study as has been made of these in the later days and published or communicated to us. While we have tried to discuss, or at least to mention, every alga credited to our territory, we have laid the greatest stress upon the results of our own studies in the field and upon specimens communicated to us, or otherwise accessible. This account, then, represents largely our own experience in attempting to obtain a knowledge of this algal flora.

GEOGRAPHY.

The limits set for this account, from the geographical point of view, range from Cape Flattery at the northwestern corner of the State of Washington, northward along the coast to the region of Kotzebue Sound on the Arctic coast of Alaska. This general region is chosen for several reasons of algal distribution. The study of the algæ of the entire western coast of North America has made it fairly plain that there are four, or possibly five regions of algal growth on the western

coast of North America, well marked off, viz.;—the Boreal, the North Temperate, the North Subtropical, and the Tropical Regions. The Tropical Region is almost unknown as regards its algal inhabitants, but from data existing in our collections, seems to have its northern boundary somewhere in the neighborhood of Magdalena Bay, on the coast of Lower California in the Republic of Mexico. It may be characterized roughly by the absence of even the warmer water Laminariaceæ and the abundance of Sargassaceæ, Dictyotaceæ, and other tropical groups. From the northern limit of the Tropical Region, there extends northward a Subtropical Region which has its northern boundary fairly sharply marked by Point Conception in Santa Barbara County in the State of California. This region is characterized by the presence of Laminariaceæ of the warmer waters, such as species of Eisenia, Pelagophycus, and Egregia (*E. lævigata* Setchell), by certain Dictyotaceæ, as well as warmer water Rhodophyceæ, all of which are either strictly limited to the northward by Point Conception, or else are to be found only in warmer isolated areas above it. On passing to the north of Point Conception, a decided change is experienced in the composition of the algal flora. The groups just mentioned are absent, and certain species characteristic of the colder waters to the north are met with, mingled in certain favored and sheltered localities with species of warmer waters. None of the strictly subtropical Laminariaceæ are met with, except occasionally the last one mentioned. No Sargassaceæ are found, nor any of the Dictyotaceæ, at least none have been found growing. In turn, we meet with the Nereocystis of the colder waters, with certain species of Laminaria, with the northern Egregia (*E. Menziesii* (Turner) Areschoug), and with other colder water forms, less striking, but no less characteristic of this region. The algal flora of the Temperate Region remains fairly unchanged until we come to Puget Sound, when we find many of its characteristic species intermingled with those of the Boreal Region. The species characteristic of the Boreal Region, extend to some extent, at least, into Puget Sound, intermingling there with the species of the warmer waters to the southward and the latter, in turn, in some special cases, extend even farther northward to the region of

Sitka, or even to Yakutat Bay or farther west on the shores of the Gulf of Alaska. When we enter Bering Sea, however, even many species, characteristic of the Boreal Region in its lower part, stop but some continue on even into the northern part. There are some reasons, at present not supported by as strong evidence as may be desired, for believing that it may be necessary ultimately to distinguish between an Upper and a Lower Boreal Region. The distribution of Thalassiophyllum, and of a few other species point toward this. The Boreal Region is to be characterized by the occurrence of *Laminaria saccharina* in various forms, certain Alariæ, certain digitate Laminariæ, Chorda, *Rhodymenia pertusa* (P. & R.) J. Agardh, forms of *R. palmata*, Agarum etc., to say nothing of the large and conspicuous *Alaria fistulosa* P. & R. which, however, is one of the species which does not extend down into the vicinity of Puget Sound. The Boreal Region has a distinct admixture of Arctic and North Atlantic species, or of species allied to these and distinct in type from those of the North Temperate Region. As we proceed north into the Bering Sea, this Arctic cast becomes more distinct as the number of species becomes less and many of the characteristic species of the Lower Boreal are conspicuous by their absence. Of the Arctic coast of Northwestern America, we know nothing, or practically nothing, of the algal inhabitants.

In this account, we have included such of the Aleutian Islands and the islands in Bering Sea as belong to the United States, more for reasons of convenience than any that are purely geographical or floral. An account of the species of Bering Island and of the Ochotsk Sea would come naturally into a consideration dealing with the shores of the Bering Sea, but for reasons of lack of opportunity of examining specimens from these shores, must necessarily be omitted.

We have spoken of regions of distribution, as may be plain from the text, from the point of view of the marine algæ. We have included in our account the species of the fresh waters and damp places of the coast country also, since the materials have come to us with the other, but as regards distribution, they do not fall into line with the marine species.

The physical geography of the Northwest Coast is, in general,

very different from the coast of North America to the south. Instead of a bold and even coast, with few deep harbors and few islands, the Northwest Coast is much indented and bordered by islands, or in fact archipelagoes, throughout much of its extent. This is significant when we are considering the question of distribution, for the greater portion of the collecting has been done in the inner and more sheltered portions of the coast, and may account for the absence of some species considered characteristic of the next lower region.

The temperatures of the surface waters are of extreme interest to us, because they are the principal factors concerned in limiting distribution and bringing about the existence of general geographical regions of distribution.

One of us (cf. Setchell, 1893) has already shown that a change in the kelp-flora takes place with the increase of every five degrees (C.) of surface temperature. The present idea of regional distribution on the western coast of North America bears out the same idea. The statement is crude, because the data are not extensive and exact enough. The average difference between the maximum and minimum of temperature for a given region is in the neighborhood of five degrees also. While the isotheres and isocrymes can be plotted only roughly at present, we find reason for believing that the isocryme of 5° C. and the isothere of 10° C. pass just below the Aleutian Islands or about the southern limit of the Upper Boreal Region; that the isocryme of 10° C. and the isothere of 15° C. pass through the Strait of Juan de Fuca or somewhere near there and correspond nearly to the southern limit of the Lower Boreal Region; that the isocryme of 15° C. and the isothere of 20° C. pass through Point Conception or near it and correspond nearly with the southern limit of the North Temperate Region of our coast; and that the isocryme of 20°C. and the isothere of 25° C. pass near Cape San Lucas, or near the southern limit of our Subtropical Region. Although there is need that these isothermal lines be determined as to position on our coast with much greater accuracy, yet the coincidence of the lines mentioned as determined by the temperature of the surface waters and the limits of the geographical regions determined by a study of the distribution of the species of algæ, is certainly

striking and seemingly of much importance in the determining of the laws governing the distribution of these plants as well as of the physiological significance which regulates the whole matter.

HISTORY.

The history of the collections of, and publications on, the algæ of the northwestern coast, is inseparably linked, both historically and geographically, with those of the Ochotsk Sea and Kamtschatka. These coasts and those of the Bering Sea form the important portion of our Upper Boreal Region of algal distribution. The first collections were made by Steller on the shores of Kamtschatka between the years 1742 and 1745. The algæ collected by this great naturalist were described by Samuel Theophilus Gmelin in his Historia Fucorum, published at St. Petersburg in 1768. This general work, the foundation of algological literature, gives the first mention of a number of our species. The first to collect algæ strictly within the limits of our territory was Dr. Archibald Menzies, who visited the Northwest Coast in a trading vessel somewhere between 1779 and 1786, and again in 1792, 1793, and 1794, as a member of the Exploring Expedition in command of Captain George Vancouver. His collections were figured and described by Dawson Turner in his monumental work, Fuci, published from 1808 to 1819, but a few of them were named and imperfectly described by E. J. C. Esper (1802) from fragments sent to him by Turner without a suspicion that they were to be used in that way. Adelbert von Chamisso, poet and botanist, collected many algæ, as well as other plants, in the expedition under Captain Otto von Kotzebue on his first voyage in 1816 and 1817, and these were described chiefly by C. A. Agardh in the years 1821 and 1822. In the years 1826 to 1829, various portions of the coast of Northwestern America were visited by the exploring expedition under the command of Captain Frederic Lütke. In the ship Seniavin with Captain Lütke, were the botanists Alexander Postels and Henry Mertens, the former of whom made the series of magnificent drawings later published in connection with Ruprecht in the Illustrationes Algarum, while

Mertens collected and made notes, some of which, communicated in the form of letters to his father, Professor Mertens in Bremen, were published in 1829 in von Schlechtendal's journal Linnæa. In the ship Moller, one of those of Lütke's expedition, in command of Captain Staninkovitch, was Kastalsky, who collected some fine materials which were published, with those of Mertens and Postels, in the Illustrationes Algarum. From these sources, many specimens were carried back to St. Petersburg from Sitka, the Peninsula of Alaska, Unalaska, the Pribilof Islands, and Kamtschatka. The drawings and specimens formed the basis of Postels and Ruprecht's large and splendid work, the Illustrationes Algarum, already referred to. This was published in 1840 and has always been rare. At about the same time that the Lütke Expedition was exploring the shores of Bering Sea, the expedition under the command of Captain Frederick William Beechey was visiting the shores of Port Clarence and Kotzebue Sound. The naturalists of the Blossom, Beechey's vessel, collected many of the higher plants, but apparently only one seaweed was brought back. This and the algæ of other coasts, collected on this expedition, were described by William Henry Harvey in Hooker and Arnott's Botany of Beechey's Voyage (between 1839 and 1841). The St. Petersburg Academy of Sciences sent Wosnessenski on a ten years trip of scientific investigation of the shores of Russian America and he collected many algæ in California and the Ochotsk Sea, possibly also some on the Northwest Coast. Dr. F. J. Ruprecht examined all the collections from the Sea of Ochotsk, and especially those brought back by Middendorf, and published the results in his Tange des Ochotskischen Meeres in 1851. This work is full of references to species and specimens from our territory and of notes on their occurrence, comparisons with similar or identical species of other regions and is to be accounted one of the most valuable contributions to the algology of the Northwest Coast, although ostensibly dealing with another region. Another exploring expedition to visit the coast and bring back collections of algæ, was the United States Exploring Expedition, under Commander Charles Wilkes, which visited the region of Puget Sound and adjoining coasts in 1841. The new species of algæ were published

by Harvey and Bailey in 1851 and the final enumeration by the same authors (cf. Bailey and Harvey) appeared in 1862. Meanwhile more settlements had been made in the territory covered by this account, and odd collections had found their way to various algologists. One of the most important was the one made by Dr. David Lyall in the region of Esquimalt, B. C. and in some other portions of Puget Sound, and sent to Professor William Henry Harvey, at Dublin, who enumerated them and described the new species in 1862. The most recent of exploring expeditions to visit any portion of the coast was that of Nordenskiöld in the Vega, which came down through Bering Strait in 1880 and visited Port Clarence and St. Lawrence Island within the limits of our territory. Professor F. R. Kjellman, the botanist of the expedition, collected algæ at these localities and later enumerated them in 1889, in his paper, Om Beringhafvets Algflora. A short paper by one of us (cf. Setchell, 1899) on the Algæ of the Pribilof Islands was one result of the efforts of the Commission on Fur Seals and Fur Seal Islands to exploit the fauna and flora of those islands and the algæ collected by the Harriman Alaskan Expedition of the summer of 1899 were enumerated and described by DeAlton Saunders in 1901. The Corallines with jointed fronds of the region about Port Renfrew by K. Yendo in 1902 and scattered references in the works of J. G. Agardh and W. G. Farlow represent well all the remaining literature directly dealing with our territory. We have carefully studied all of the literature mentioned above and have attempted to incorporate the references to species and localities in the following account, placing each under its proper species, as we have recognized it, so far as we have been able to do so.

COLLECTIONS.

While the collections mentioned in the preceding paragraphs have been for the most part inaccessible to us, a very considerable amount of material has been brought together from the Northwest Coast, probably the largest collected together in any one place and has formed the basis for the present enumeration.

It may be described as follows:—in Herb. D. C. Eaton, a number of species collected through the courtesy of the Alaska Commercial Company and mostly numbered, named, and the duplicates distributed to Herb. Farlow and to our own collection; in Herb. University of California, a few specimens labelled as being from Bering Sea, collected in 1872, but without farther notes; a collection made at the Pribilof Island of St. Paul, in 1895, by Charles H. Townsend of the U. S. F. C. Str. Albatross, under the directions of the U. S. Commissioner of Fisheries; a collection in the years 1896–97, made also at the Island of St. Paul, by A. W. Greeley and R. E. Snodgrass, by the direction of President David Starr Jordan, then acting as head of the U. S. Commission on Fur Seals and Fur Seal Islands; collections made in the summer of 1899, at various points in Norton Sound, Alaska, by H. M. Rhodes and P. M. Newhall, of the U. S. C. & G. S. Str. Patterson, under J. F. Pratt, Assistant U. S. C. & G. S. in charge; collections in various parts of the eastern side of Bering Sea, made in the summer of 1900, by R. C. McGregor of the U. S. C. & G. S. Str. Pathfinder, in charge of J. J. Gilbert, Assistant U. S. C. & G. S.; collections made in the summer of 1894, by Charles H. Townsend of the U. S. F. C. Str. Albatross, at the Bay of Morozof (Morzhovoi Bay) on the Peninsula of Alaska and at Agattu and Kyska Islands in the westernmost portions of the Aleutian Islands, in accordance with the directions of the U. S. Commissioner of Fisheries; very extensive collections made in the summer of 1899, by an expedition from the University of California, consisting of W. L. Jepson, L. E. Hunt, A. A. Lawson, and W. A. Setchell, with assistance from the Alaska Commercial Company, the Pacific Steam Whaling Company, the Pacific Coast Steamship Company, and Assistant Pratt and officers of the U. S. C. & G. S. Str. Patterson, from the following localities:—St. Michael, Cape Nome, Bay of Unalaska, Delarof Harbor on Unga Island, Karluk, Uyak Bay, St. Paul (the last three on Kadiak Island), Orca, Juneau, and Sitka, Alaska, and Departure Bay, B. C.; a collection gathered for us in 1899, at Delarof Harbor on Unga Island, Alaska, J. B. Downing, Master of the Pacific Steam Whaling Company's Str. Excelsior; a collection obtained through Rev. Albin Johnson, a missionary,

gathered at Yakutat Bay, Alaska in 1899; a collection from Sitka, Alaska, forwarded by Miss Ida M. Rodgers of the Alaska Historical and Ethnological Society in 1889; a few species, collected at Esquimalt in 1898, by W. A. Setchell at an unfavorable tide; many species collected by Miss Josephine E. Tilden at various points in the region of Puget Sound and distributed in her American Algæ (1894–1902); extensive collections at Whidbey Island, Orcas Island, San Juan Island, Seattle, Wash., and other localities in Puget Sound, by N. L. Gardner from 1897 to 1901; a collection from Port Renfrew, B. C., by Miss Eloise Butler and Miss Jessie E. Polley, determined by Frank S. Collins of Malden, Mass., and determinations and some of the specimens communicated to us; a small collection by G. W. Lichtenthaler, made at Port Angeles, Clallam County, Wash., and on Vancouver Island, B. C., determined by Mr. Collins and the names and some of the specimens sent to us; and several fresh water species collected in the vicinity of Seattle by Professors H. R. Foster and T. C. D. Kincaid of the University of Washington. Finally, we have to record that various specimens by some of the collectors mentioned above and some of the specimens collected by DeAlton Saunders on the Alaskan coast have been distributed in Collins, Holden and Setchell, P. B.-A., and these have been examined by us and the references incorporated into our account.

SCOPE.

The aim of the writers of this account, as has been hinted at in the paragraph of the introduction, is to include every alga which is known to them to occur on the coast or in the coast country from the latitude of Cape Flattery northward to the Arctic Ocean. We have included as belonging to the northwestern coast of North America, such islands in the region of Bering Sea as belong to American countries. This has caused us to include the Aleutian Islands, the Pribilof Islands, and St. Lawrence Island. We have enumerated all species belonging to the groups of Cyanophyceæ, Phæophyceæ, Rhodophyceæ, and most of the Chlorophyceæ. We have omitted all account of the Desmidiaceæ and the Diatomaceæ, since our knowledge of these

forms is not sufficient to allow us to include them. The species of the fresh waters and of damp localities removed from the immediate shores, but only within a few miles of the coast line, have been included, because the materials are available and often come into direct connection with the account of the marine species. Much more work needs to be done upon both classes of algæ in this territory and it is our purpose to continue, regarding the present account as tentative and preliminary.

CITATIONS.

In citing, whether it be generic or specific names, localities, or references in the various published writings or published exsiccatæ, we have tried to follow a conservative and, as we hope, an intelligible course. We have followed largely the order and nomenclature of the Engler and Prantl System, departing from it only where it seemed absolutely necessary. In the use of generic names, we have followed usage rather than strict priority, holding that a name which has been recognized for a quarter of a century, or thereabouts, is to be considered fixed and not to be unsettled simply because another may have been proposed earlier, but hitherto neglected for good or even for no real reason. We have preferred to devote our time to the study of the plant itself. In the case of specific names, we have been unwilling to unsettle a name of this rank, which has been long in use, unless the earlier name is so plainly applicable that there can be absolutely no doubt as to the application. Where it has become necessary to unite a series of proposed species, then the earliest name of undoubted application has been chosen and this has also been done in the case of some species, recently proposed but not yet fixed in the literature. We have not attempted to give a list of citations under each species, but have only cited such references as became necessary to indicate what is meant, or to give our authority for mentioning it as occuring in certain localities. The list of localities under each species has been made as full as our knowledge has permitted and in each case, the name of the col-

lector, or of the author recording it as from that locality, has been given, following the usual method of citation in each instance, to agree with the list of authors and their works appended to this account. In case of the collections which are extensive, only the initials of certain collectors have been printed, but these will be plain from the paragraph entitled "Collections". The names of the localities have been given in accordance with the best authority known to us and have been arranged, in general, from north to south. In some cases, however, this has been departed from, but, as we think, without being liable to cause confusion. The specimens cited as having been examined by us, are, with very few exceptions, preserved in our own collections, at present deposited with the Herbarium of the University of California.

ACKNOWLEDGMENTS.

We desire to make acknowledgment of the great assistance we have received from many sources in the prosecution of our work. To all of the collectors, officials, and corporations mentioned in the paragraph on "Collections", we return our sincerest thanks. Without the aid of these, it would have been impossible to accomplish anything whatsoever, in the large task we had set for ourselves, Some several thousand specimens have been provided through the generosity or personal effort of those mentioned, which have enabled us to clear up many points which seemed beyond hope. To Mr. Frank Shipley Collins of Malden, Mass., we are indebted for the determination of nearly all of the Chlorophyceæ and for invaluable assistance at many other points. Through Mr. Collins, we are very much indebted, also, to Dr. Tracy Elliot Hazen, for assistance in determining various Chætophoraceæ and Ulothriciaceæ. We desire to thank Professor F. R. Kjellman of Upsala, Sweden, for examinig a set of our Alariæ and returning specimens and notes for our guidance. We feel very grateful to M. Foslie, Esq., of Trondheim, Norway, for similar services in connection with our crustaceous Corallinaceæ. Professor George Davidson, of the University of California, has

been of the greatest help in aiding us in finding the correct geographical names and in fixing doubtful localities. To all of these persons, we return our most sincere thanks.

CYANOPHYCEÆ.

The members of this group are sometimes placed among the algæ, sometimes placed separately in a division with their near relatives the Schizomycetes or Bacteria, which is called Schizophyta. While we believe that this is the proper method of classification, we also feel that the term algæ is only a general one and the recognition that the Cyanophyceæ and Bacteria are phylogenetically distinct from groups, such as the Chlorophyceæ, the Phæophyceæ, etc. does not preclude the extension of the term to them. These groups are also distinct from one another in a similar way, but perhaps less pronouncedly. The greater number of the Cyanophyceæ enumerated as belonging to our territory are not marine, but are largely cosmopolitan fresh water species, able to endure a considerable range of temperature. In studying the marine species of this group, there seems to be a decided falling off, both in the number of species and abundance of individuals, as we proceed to the northward. This does not hold good for the species of the fresh waters. In studying and arranging our forms, we have followed the works of Bornet and Flahault (1886—1889) as regards the heterocysted forms and the monograph of Gomont (1893) for the homocysted forms. The Chroococcaceæ and the Chamæsiphoniaceæ present difficulties hard to overcome. For genera, much help was obtained from Kirchner's arrangement (1898), also considerable assistance as regards species. The specific determinations of these groups, however, will remain very uncertain until some worker follows the example of the French Algologists mentioned above, and gives us a good practical monograph. At present the student must consult the special papers of Nægeli (1849), Meneghini (1846), Kirchner (1878), etc.

FAMILY CHROOCOCCACEÆ.

Chroococcus rufescens (Brebisson) Nægeli.

Forming with Stigonema a reddish coating on a rock five hundred feet above sea level. Prince William Sound, Alaska, *Saunders* (1901, p. 396).

Chroococcus turgidus (Kuetzing) Nægeli.

Among other algæ in pools of fresh water or on dripping rocks. Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5023a!; Juneau, Alaska, *Saunders* (1901, p, 396); in brackish water, Whidbey Island, Wash., *N.L.G.*, No. 472!

Glœocapsa ambigua f. fuscolutea Nægeli.

Among other algæ, especially *Dichothrix Baueriana* (Grunow) B. & F. and *Schizothrix Braunii* Gomont, in a mountain stream. Orca, Alaska, *W. L. Jepson*, No. 5175!

The cell walls of this form are thick, opaque and reddish or yellowish brown.

Glœocapsa ambigua f. violacea Nægeli.

Intermingled with the last.

The only difference between this form and the last is in the color of the cell walls which are distinctly violet and somewhat more opaque.

Glœocapsa atrata Kuetzing.

Intermingled with the last two.

The present species differs from the last two in having the walls transparent and either colorless or else very light blue. They all seem to be forms of one species which is variable in this respect.

Glœocapsa polydermatica Kuetzing.

With other Cyanophyceæ, forming a yellowish firm jelly on dripping rocks. Near Iliuliuk, Unalaska, Alaska *W.A.S. and A.A.L.*, No. 4031!

The specimens referred here have blue green cell contents and colorless stratified walls. The families are one or two-celled. The cells measure 21-22 μ in diameter.

Aphanocapsa Castagnei (Kuetzing) Rabenhorst.

In fresh or sulphur waters. Point Barrow, Alaska, *Farlow* (1885, p. 192); Ravenna Park, Seattle, Wash., *N.L.G.*, No. 400!

Aphanothece stagnina (Sprengel) A. Braun.

Point Barrow, Alaska, *Farlow* (1885, p. 192).

Aphanothece microspora Rabenhorst.

On dripping rocks. Juneau, Alaska, *Saunders* (1901, p. 397).

Aphanothece Castagnei (Brebisson) Rabenhorst.

In a jar of water in the laboratory. University of Washington, Seattle, Wash., *N.L.G.*, No. 590!

The determination is not without some doubt, but the measurements seem to coincide with those given for this species.

Microcystis marginata (Meneghini) Kuetzing.

Forming slimy coatings on dripping rocks. Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5023a!; Juneau, Alaska, *Saunders* (1901, p. 397).

The Unalaska specimen seems to belong here although the cells are often twice as long as broad. A consultation of Meneghini's figure (1846, pl, 13, f. 1 and 1a) will show a similar variation. The habit is very strongly of this species.

Gomphosphæria aponina Kuetzing.

Floating intermingled with other algæ in brackish waters. Whidbey Island, Wash., *N.L.G.*, Nos. 296!, 301!, 472!

Oncobyrsa Cesatiana Rabenhorst.

Plentiful on water-moss in running fresh water. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5036!

These plants appeared as small, golden yellow, nearly spherical colonies at a place in the rivulet where the water was most rapidly flowing.

FAMILY CHAMÆSIPHONIACEÆ.

Xenococcus Schousbœi Thuret.

On various filamentous Cyanophyceæ and Chlorophyceæ in

salt and brackish water. Whidbey Island, Wash., *N.L.G.*, Nos. 301!, 670!

The plants examined under No. 670 showed fine conidia.

Pleurocapsa fuliginosa Hauck.

On piles of a wharf. Seattle, Wash., *N.L.G.*, No. 306b!

Dermocarpa fucicola Saunders.

On various algæ. On Iridæa, Victoria, B. C., *Tilden*, Nos. 328a!, 328c!; west shore of Whidbey Island, Wash., *N.L.G.*, 291!; on Gelidium, East Sound, Orcas Island, Wash., *N.L.G.*, No. 522a!; on Gigartina, west shore of Whidbey Island, Wash., *N.L.G.*, No. 77!; on Odonthalia, west shore of Whidbey Island, Wash., *N.L.G.*, No. 92!; on Amphiroa, west shore of Whidbey Island, Wash., *N.L.G.*!; on Fucus, Seattle, Wash, *Saunders* (1901, p. 397) and in Collins, Holden and Setchell, P. B.-A., No. 801!

The present species occurs along the western coast of North America from Puget Sound to Monterey, California, and grows on all sorts of algæ. In its younger and purely vegetative condition, the patches are small and the cells are long and narrow, 4–8 μ broad and up to 28 μ high, of equal breadth throughout. Soon they begin to broaden above, giving them something of a pear-shape. In this condition they correspond closely to the description and figures given by Sauvageau (1895, p. 8, pl. 7, f. 2, 3) of his *D. Biscayensis*.

Sauvageau's specimens, which grew on Sargassum, do not show conidia, but our specimens show that when the cells proceed to this condition, they become still more swollen in the upper part, while the lower part remains narrow, resembling a sort of stipe. In conidial condition the cells measure 60–65 μ in height and 25–35 μ in diameter. While we have used the name *D. fucicola*, we believe that when fruiting specimens can be compared, that this species will be found to be identical with *D. Biscayensis* Sauvageau. Saunders has quoted Sauvageau as claiming a breadth of 25–30 μ for his species, but as a matter of fact that is the height, the breadth being given as 4.5–6 μ. Savageau also speaks of the cells of his species as being broader above than below.

Dermocarpa prasina (Reinsch) Bornet.

Abundant on Sphacelaria. From Puget Sound to the Shumagin Islands, *Saunders* (1901, p. 397).

Chloroglœa tuberculosa (Hansgirg) Wille.

Epiphytic on Cladophora. Port Renfrew, B. C. *Tilden*, No. 382! (under *Pringsheimia scutata* f. *Cladophoræ*).

The plants referred here with some doubt, form irregular, apparently bright green masses on the branches of Cladophora and answer exactly to Wille's description and plate of the habit (1900, p. 2, pl. 1) as well as to those of Hansgirg (1892, p. 240 pl. 1, f. 9). In every respect these plants agree, with the exception that in the specimens distributed by Miss Tilden, there are certain large cells, somewhat irregularly placed, which have the appearance of being young conidangia. There is certainly nothing looking like Pringsheimia in the specimens distributed.

FAMILY OSCILLATORIACEÆ.

Spirulina major Kuetzing.

Pools of slightly brackish water. Monroe's Landing, near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 411!

Spirulina subsalsa f. **Oceanica** (Crouan) Gomont.

In mud of pools of brackish water on salt marshes. Whidbey Island, Wash., *N.L.G.*, Nos. 446!, 471!, 615!, and in Collins, Holden and Setchell, P. B.-A., No. 954!

Oscillatoria princeps Vaucher.

In a fresh water pond. Near Seattle, Wash., *Tilden*, No. 296!

Oscillatoria proboscidea Gomont.

In a small pond of fresh water. Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5023a!

Oscillatoria sancta Kuetzing.

In a small pond of fresh water. Port Townsend, Wash., *N.G.L.*, No. 444!

Oscillatoria limosa Agardh.

Floating on ditches of slightly brackish water. La Conner, Skagit County, Wash., *N. L. G.*, Nos. 333!, 334!; Whidbey Island, Wash., *N.L.G.*, No. 615!

The determinations given above are not absolutely satisfactory to us.

Oscillatoria Bonnemaisonii Crouan.

In salt marshes. Whidbey Island, Wash., *N.L.G.*, No. 252!

The filaments measure only 12-15 μ which is small for this species. Otherwise, the characters are in agreement with the description.

Oscillatoria nigro-viridis Thwaites.

In salt marshes. Whidbey Island, Wash., *N.L.G.*, No. 615!; Seattle, Wash., Professor *H. R. Foster*, No. 601?

Oscillatoria tenuis var. **tergestina** (Kuetzing) Rabenhorst.

In pools of fresh or slightly brackish water. Whidbey Island, Wash., *N. L. G.*, Nos. 470!, 596!; Seattle, Wash., *N. L. G.*, No. 396!

Oscillatoria tenuis var. ?

Floating in slightly brackish water in a ditch. La Conner, Skagit County, Wash., *N.L.G.*, No. 333!

Agrees well with *O. tenuis*, except that it is hardly at all torulose.

Oscillatoria amphibia Agardh.

In mud at bottoms of ponds. Whidbey Island, Wash., *N.L.G.*, Nos. 460a!, 470!

Oscillatoria geminata Meneghini.

On mud by the roadside. La Conner, Skagit County, Wash., *N.L.G.*, No. 331!

The determination is not absolutely certain.

Oscillatoria chlorina Kuetzing.

In mud at the bottoms of shallow ponds of fresh water. Whidbey Island, Wash., *N. L. G.*, No. 460!, and in Collins, Holden and Setchell, P. B.-A., No. 901!

Oscillatoria splendida Greville.

On mud in fresh water pools. Seattle, Wash., *N.L.G.*, Nos. 578!, 580!

Oscillatoria splendida f. **uncinata** Setchell and Gardner f. nov. PLATE 19.

Agreeing in all respects with the type except that the tip of the filament shows an unusually long, capitate cell which is very markedly uncinate, and the filaments are flexuous and coiled.

On damp mud at the bottom of a pool nearly dried up. Oak Harbor, Whidbey Island, Wash., *N.L.G.*, No. 574!

Oscillatoria amœna (Kuetzing) Gomont.

Lining the bottom of the outlet of a hot spring, temperature 80°–120° F. Sitka, Alaska, *Saunders* (1901, p. 397); on mud in a ditch of fresh water, Seattle, Wash., *N.L.G.*, No. 580!

Oscillatoria lætevirens Crouan.

In a salt marsh. Head of Penn's Cove, Whidbey Island, Wash., *N.L.G.*, No. 471!

The specimen is referred here with some doubt as the filaments are somewhat larger than the measurements given for this species, and the cells are provided with large granules.

Oscillatoria Okeni Agardh.

In pond of brackish water. Monroe's Landing, near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 596!

Phormidium foveolarum (Montagne) Gomont.

Mixed with *Ph. autumnale* (Agardh) Gomont, in ditches by the roadside. Pleasant Ridge, near La Conner, Skagit County, Wash., *N.L.G.*, No. 331!

The sheaths of this species are diffluent into a very soft jelly much different from that of the species associated with it in this locality.

Phormidium Valderianum (Delponte) Gomont.

On dripping timber of old mill. Sitka, Alaska, *W.A.S. and A.A.L.*, No. 5204!

The Phormidium is intermingled with a sterile Zygnema.

The filaments of the Phormidium are rather slender, measuring 1.5–1.8 μ in diameter.

Phormidium laminosum (Agardh) Gomont.

On dripping rocks or in spring water. Orca, Alaska, *Saunders* (1901, p. 398); San Juan Island, Wash., *N.L.G.*, No. 485!

Phormidium tenue (Meneghini) Gomont.

In various situations, submerged and emergent, in fresh water. Walls of Amaknak Cave, Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3292!; Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 450!; Oak Harbor, Whidbey Island, Wash., *N.L.G.*, No. 574!; Seattle, Wash., *N.L.G.*, Nos. 593!, 597!

No. 3292 shows the form with the uncinate tip almost entirely.

Phormidium inundatum Kuetzing.

On a dripping water pipe or in watering troughs. Victoria, B. C., *N.L.G.*, No. 319!; Seattle, Wash., *N.L.G.*, No. 393!

Phormidium Corium (Agardh) Gomont.

Mixed with other algæ, particularly of the same family, either submerged or exposed to the air. Cape Nome, Alaska, *W.A.S.!*; Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5029c!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5045x!

The specimens referred here are not altogether typical, but seem to belong to this species rather than to any other described.

Phormidium papyraceum (Agardh) Gomont.

At the outlet of a lake. Orcas Island, Wash., *N.L.G.*, No. 613!

Phormidium Retzii (Agardh) Gomont.

Growing on a submerged log. Green Lake, Seattle, Wash., *N.L.G.*, No. 369!

Mixed with the following.

Phormidium ambiguum Gomont.

Growing on a submerged log. Green Lake, Seattle, Wash., *N.L.G.*, No. 369!

Mixed with the preceding.

Phormidium favosum (Bory) Gomont.

Floating or attached to wood in streams or on the ground. Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5020e!; Juneau, Alaska, *W.A.S. and A.A.L.*, Nos. 5188x!, 5190x!

No. 5020e represents an unusually slender form, No. 5190x represents a typical form of what Gomont calls var. a, and No. 5188x a typical form of what the same writer calls var. b.

Phormidium Treleasei Gomont.

Mixed with other Cyanophyceæ in a scum on sluggish small streams. Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5022e!

This very slender species (0.6–0.8 μ) with elongated cells, has been found hitherto only in thermal waters (Arkansas Hot Springs and Yellowstone National Park), but this specimen seems to belong under it, though of cold waters.

Phormidium uncinatum (Agardh) Gomont.

Forming more or less extended blue-black layers, either submerged or on the surface of the ground. St. Michael, Alaska, *W.A.S.*, No. 5236x!; near Iliuliuk, Unalaska, *W.A.S. and A.A.L.*, No. 5034!; Orca, Alaska, *W.A.S. and A.A.L.*, No. 5172!; LaConner, Skagit County, Wash., *N.L.G.*, No. 331!; Seattle, Wash., *N.L.G.*, Nos. 397!, 400!

This is a very wide-spread species and is frequently so close to the following that it is distinguished with difficulty.

Phormidium autumnale (Agardh) Gomont.

Similar to the last in appearance and habit. Iliuliuk, Unalaska, *W.A.S and A.A.L.*, No. 5034!; Kukak Bay, Alaska, *Saunders* (1901, p. 398); Sitka, Alaska, *W.A.S. and A.A.L.*, No. 5205!; Coupeville, Whidbey Island, Wash., *N.L.G.*, Nos. 450!, 609!; La Conner, Skagit County, Wash., *N.L.G.*, No. 336!; Seattle, Wash., *N.L.G.*, Nos. 394!, 401!, 499!

Lyngbya æstuarii f. limicola Gomont.

On mud in salt marshes. Whidbey Island, Wash., *N.L.G.*, Nos. 451!, 599!, and in Collins, Holden and Setchell, P. B.-A., No. 903!

Lyngbya æstuarii f. natans Gomont.

Floating on pools in salt marshes. West and east shores of Whidbey Island, Wash., *N.L.G.*, Nos. 421!, 571!, 598!, and in Collins, Holden and Setchell, P. B.-A., No. 904!

Lyngbya æstuarii f. ferruginea Gomont.

In pools in salt marshes. Near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 301!

Intermingled with the next form.

Lyngbya æstuarii f. spectabilis (Thuret) Gomont.

Intermingled with the last.

Lyngbya æstuarii f. æruginosa Gomont.

Floating on pools in salt marshes. Whidbey Island, Wash., *N.L.G.*, Nos. 230!, 429!; Port Townsend, Wash., *N.L.G.*, No. 610!, and in Collins, Holden and Setchell, P. B.-A., No. 902!

Lyngbya semiplena (Agardh) J. Agardh.

Salt marsh. Whidbey Island, Wash., *N.L.G.*, No. 615!

Lyngbya spirulinoides Gomont.

Floating among various filamentous algæ. Lake Washington, Seattle, Wash., *N.L.G.*, No. 493!

Lyngbya ærugineo-cærulea (Kuetzing) Gomont.

Intermingled with other filamentous algæ. Small pond on an island in the Muir Glacier, Alaska, *Saunders* (1901, p. 398); Juneau, Alaska, *Saunders* (1901, p. 398).

Lyngbya versicolor (Wartmann) Gomont.

Floating on a deep pool of fresh water. Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5024!

Lyngbya Lagerheimii (Moebius) Gomont.

Among various filamentous algæ. Whidbey Island, Wash., *N.L.G.*, No. 303!; sulphur spring, Ravenna Park, Seattle, Wash., *N.L.G.*, No. 400!

Lyngbya ochracea (Kuetzing) Thuret.

In gelatinous masses on moist bank of creek. Near Port Renfrew, B.C., *Tilden*, No. 588!

Symploca hydnoides var. **genuina** Gomont.

Growing on logs between tide marks. Whidbey Island, Wash., *N.L.G.*, No. 302!, and in Collins, Holden and Setchell, P. B.-A., No. 905!

Symploca læteviridis Gomont.

On mud-covered rocks near the upper tide limit. St. Michael, Alaska, *W.A.S.*, No. 5248x!

The habit of this plant is slightly Symplocoid and the color light green. The filaments measure 3 μ in diameter, are distinctly torulose, and show a terminal cell either blunt or somewhat pointed. It certainly seems strange to find a plant, hitherto known only from the tropical locality of Key West, so far north, but it is perhaps no greater surprise than finding a plant of distinctly thermal waters, in cold waters.

Symploca muscorum (Agardh) Gomont.

Among mosses on damp ground. Newhall, Orcas Island, Wash., *N.L.G.*, No. 564!

If, as seems to be the case, we are right in referring these specimens to this species, they represent a very slender form, as the trichomes are only 3 μ in diameter.

Plectonema roseolum (Richter) Gomont.

On dripping rocks, intermingled with Rivularia and Hassallia. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4005!

The specimen shows filaments which are only sparingly branched, but with measurements and dotted dissepiments in agreement with No. 191, Phykotheka Universalis. There is no rosy tint perceptible in the composite mass.

Microcoleus chthonoplastes (Flora Danica) Thuret.

On mud in salt marshes. Whidbey Island, Wash., *N.L.G.*, Nos. 299!, 451!, 615!, and in Collins, Holden and Setchell, P. B.-A., No. 906!

Microcoleus tenerrimus Gomont.

In a salt marsh. Whidbey Island, Wash., *N. L. G.*, Nos. 302!, 615!

Microcoleus vaginatus (Vaucher) Gomont.

On damp ground. Glacier Bay, Alaska, *Saunders* (1901, p. 397); La Conner, Skagit County, Wash., *N.L.G.*, No. 335!

The specimen collected by Gardner belongs to Gomont's variety *monticola*.

Schizothrix lacustris A. Braun.

In a pool of fresh water, near Prince William Sound, Alaska, *Saunders*, No. 300! (1901, p. 397).

Schizothrix lardacea (Cesati) Gomont.

Forming bright rose-red tufts on rocks exposed to fresh water spray. Near Iliuliuk, Unalaska, *W.A.S. and A.A.L.*, Nos. 4045!, 5038!, and in Collins, Holden and Setchell, P. B.-A., No. 955!; Orca, Alaska, *Saunders* (1901, p. 396).

Schizothrix rubra (Meneghini) Gomont.

Forming scum on deep pool of fresh water. Glacier Valley, Unalaska, Alaska, *A.A.L.*, No. 5025!

The specimens are preserved in formalin solution and while the filaments agree, little can be made out of the color.

Schizothrix Braunii Gomont.

On dripping rocks. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4032!; Orca, Alaska, *W. L. Jepson*, No. 5175!

Most of the sheaths are colorless, but some are of the characteristic blue-black color of this species. The dissepiments are granular.

FAMILY NOSTOCACEÆ.

Nostoc Linckia (Roth) Bornet.

Floating, intermingled with other algæ, on ponds of fresh water. Near Coupeville, Whidbey Island, Wash., *N.L.G.*, Nos. 462!, 594!

Nostoc rivulare Kuetzing.

Forming floating masses of light brown jelly, in springs and pools. Near Huntville, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4095!; near Green Lake, Seattle, Wash., *N.L.G.*, No. 584!

Nostoc carneum Agardh.

Forming brown floating masses of jelly on surface of streams. Glacier Valley, Unalaska, Alaska, *A.A.L.*, Nos. 5020 a and b!, 5026!; Green Lake, Seattle, Wash., *N.L.G.*, No. 587!

Nostoc spongiæforme Agardh.

Floating in a small pool of fresh water. Edge of Green Lake, Seattle, Wash., *N.L.G.*, Nos. 383!, 585!

No. 383, collected in May, 1901, has no spores, but No. 585, collected in the same pool in July, 1901, has an abundance of young spores.

Nostoc muscorum Agardh.

Forming soft gelatinous lumps and masses of various shapes, on rocks among mosses. Amaknak Cave, Amaknak Island, Bay of Unalaska. Alaska, *W.A.S. and A.A.L.*, No. 3295!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4085!; moist ground just above high water mark, Whidbey Island, Wash., *N.L.G.*, No. 422?

The last number is young and shows no spores. No. 394, Tilden, American Algæ, collected at Port Renfrew, B. C., is too scanty for determination, but what there is shows a frond too tough to belong to this species, but which, in consistency at least, approaches the following.

Nostoc commune Vaucher.

Assuming various shapes, from discoid thalli to flat expansions of considerable extent, on soil or on rocks. St. Michael, Alaska, *W.A.S.*, No. 5157y!; Iliuliuk, Unalaska, *W.A.S. and A.A.L.*, No. 4030!; near Hidden Glacier, Yakutat Bay, Alaska, *Saunders* (1901, p, 397); near Glacier Bay, Alaska, *Saunders* (1901, p. 397);. Whidbey Island, Wash., *N.L.G.*, Nos. 376!, 611!

Nostoc expansum Harvey and Bailey.

Puget Sound, *Harvey and Bailey* (1851, p. 372), *Bailey and Harvey* (1862, p. 164, pl. 6, f. 1, 2).

This species seems to be unknown, but must be near to, if not identical with the preceding.

Nostoc sphæricum Vaucher.

On dripping rocks among mosses. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3291?

The habit and arrangement of the trichomes of this specimen resemble the original description and figures. The trichomes are 5.5-6 μ in diameter, which is large for this species. There are no spores.

Nostoc minutum Desmazieres.

On dripping rocks, much mixed with other algæ of a gelatinous nature. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4032?

The thalli are minute and spherical. The trichomes are densely intertwined, and measure 3 μ or less. The periderm is firm. There are no spores.

Nostoc microscopicum Carmichael.

Floating, intermingled with other algæ. Whidbey Island, Wash., *N.L.G.*, No. 612?; Seattle, Wash., *N.L.G.*, Nos. 352!, 562!, 581!

Nostoc sphæroides Kuetzing.

Forming a soft bluish green coating on rocks. Juneau, Alaska, *Saunders*, No. 75? (1901, p. 398).

Nostoc cæruleum Lyngbye.

In a ditch of fresh water. Near Seattle, Wash., *N.L.G.*, No. 586?

Seems to belong here, but most of the specimens have passed maturity.

Nostoc pruniforme (L.) Agardh.

In ditches of fresh water. Near Seattle, Wash., *N.L.G.*, Nos. 374!, 375!

Nostoc verrucosum (L.) Vaucher?

Fresh water pools at Port Clarence, Alaska, *Harvey* (1872, p. 463.)

Anabæna variabilis Kuetzing.

In ditches and ponds. Whidbey Island, Wash., *N.L.G.*, No. 573!; Seattle, Wash., *N.L.G.*, Nos. 588!, 607!

Anabæna sphærica B. & F.

Floating on the surfaces of small ponds. Whidbey Island, Wash., *N.L.G*,, No. 462!; Port Townsend, Wash., *N.L.G.*, No. 436!

The filaments are agglutinated together in parallel bunches; the spores are very nearly spherical and 10 μ broad; they begin to form near one heterocyst and proceed in their formation, toward the other. In general, the plants noted above come very near to this species, at least.

Anabæna Flos-aquæ (Lyngbye) Brebisson.

Floating on great abundance on quiet water. Lake Union, Seattle, Wash., *N.L.G.*, No. 387!

The filaments are circinate and agree with those of this species in every way, but the plants are all sterile and consequently the determination cannot be absolutely certain.

Anabæna catenula (Kuetzing) B. & F.

Floating on shallow ponds or sluggish streams. Huntville, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4095?; Glacier Valley, Unalaska, Alaska, *A.A.L.*, Nos. 5022?, 5028?; near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 605!; Green Lake, Seattle, Wash., *N.L.G.*, No. 380!

The Unalaska specimens are somewhat doubtful, since they seem to approach too near to the following, but are probably forms of the present with spores adjacent to the heterocysts.

Anabæna oscillarioides Bory.

Floating on pools and lakes, or on moist ground. Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 462!; Seattle, Wash., *N.L.G.*, Nos. 352!, 353!, 372!, and in Collins, Holden and Setchell, P. B.-A., No. 907!; Port Townsend, Wash., *N.L.G.*, No. 436!

No. 436 is a slender form with trichomes not over 4 μ in diameter and with spores not over 30 μ long, perhaps belonging to the var *stenospora*.

Nodularia Harveyana (Thwaites) Thuret.

On mud by the roadside. Near LaConner, Skagit County, Wash., *N.L.G.*, No. 335!

The filaments are 6 μ in diameter, and the spores are 8 μ in diameter.

Nodularia armorica Thuret?

Floating on the surfaces of quiet ponds. Near Coupeville, Whidbey Island, Wash., *N. L. G.*, No. 602!; Port Townsend, Wash., *N.L.G.*, No. 436!

The specimens referred somewhat doubtfully to this species seem intermediate between it and *N. sphærocarpa* B. & F. The filaments are 10 μ in diameter, while the trichomes are 6 μ in diameter. The spores are nearly spherical and show some indications of biconcave dissepiments. They measure, in the riper, but not yet fully mature ones, 9–10 μ by 6–7 μ.

Nodularia spumigena f. **major** (Kuetzing) B. & F.

In a pond of slightly brackish water. Penn's Cove, near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 411!

The spores in the number quoted above are scanty and mostly young. Some which are nearly ripe, measure 17–18 μ by 7–8 μ.

Cylindrospermum licheniforme (Bory) Kuetzing.

On mud or moist sand. Near Oak Harbor, Whidbey Island, Wash., *N.L.G.*, No. 600!; near Mt. Vernon, Skagit County, *N.L.G.*, No. 332!; near Seattle, Wash., *N.L.G.*, Nos. 367!, 391!

The specimens quoted above seem to be typical forms of this species. Gardner has collected a specimen (No. 335, LaConner, Skagit County, Wash.,) which also comes very close to it, but the ripe spores are only 15μ by 7 μ.

Cylindrospermum muscicola Kuetzing.

In a small stream of running water. Orcas Island, Wash., *N.L.G.*, No. 474!

The ripe spores are 18 μ by 10 μ and are more oval than oblong.

Cylindrospermum catenatum Ralfs.

Floating in quiet water of a stream. Tracyton, Kitsap County, Wash., *Tilden*, No. 395!

The material in this number is excellent, but it is difficult to find spores in position. They appear to be in chains and answer to the description of those of this species.

Cylindrospermum sp. ?

In a specimen collected floating on a small pond near Coupeville, Whidbey Island, Wash., by Gardner (No. 606), the spores are unripe, but the filaments have heterocysts at both ends. It probably belongs to *C. licheniforme* (Bory) Kuetzing.

FAMILY SCYTONEMATACEÆ.

Microchæte tenera Thuret.

Forming grayish tufts on dripping rocks. Walls of Amaknak Cave, Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3292!

The heterocysts are chiefly basal, but there are occasional oblong intercalary ones. The general aspect is that of a Calothrix, but it lacks any indication of a terminal hair.

Microchaete robusta Setchell and Gardner sp. nov.

In tufts and stellate clusters on water weeds; filaments elongated and perfectly cylindrical, decumbent at the very base, but scarcely thickened, 16–18 μ in diameter; trichome composed of cells which are quadrate or slightly longer than broad in the lower portion and which are shortened to one-third as long as broad in the upper part, 12 μ in diameter and the cells 6–16 μ long, æruginous and filled with fine granules; sheath thin, at first, but later stratified, hyaline; heterocysts basal and intercalary, the former being spherical or nearly so, while the latter are elongated and rectangular.

In ponds of fresh water. Near Seattle, Wash., Professor *T. C. D. Kincaid*, No. 768!

Apparently a very distinct species. and referred to this genus rather than to Calotrhix, on account of the filaments being of uniform width from base to apex. The terminal cells of the filaments are short and torulose, and the uppermost cells are nearly if not quite colorless, reminding one of the terminal hair of the Rivulariaceæ, but the colorless portion of trichome does not taper at all.

Scytonema varium Kuetzing.

On rocks moistened by spray from a waterfall. Juneau, Alaska, *Saunders*, No. 76! (1901, p. 398.)

Scytonema Hofmanni Agardh.

On dripping rocks. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4031!

Scytonema mirabile (Dillwyn) Bornet.

On moist ground or in fresh water streams. Kukak Bay and Glacier Bay, Alaska, *Saunders* (1901, p. 398).

This species has not occurred to us, but Saunders has mentioned it under the synonyms, *S. figuratum* and *S. mirabile*. We do not know whether he intended to indicate different species or the same species, but Bornet has demonstrated that the *S. figuratum* Agardh is the same as the *Conferva mirabilis* Dillwyn (cf. Bornet, 1889, p. 12).

Scytonema Myochrous (Dillwyn) Agardh.

Forming small tufts on rocks in a brook. Glacier Bay, Alaska, *Saunders* (1901, p. 398).

Hassallia byssoidea f. saxicola Grunow.

Among mosses on dripping rocks. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4005!

Tolypothrix distorta (Fl. Dan.) Kuetzing.

Floating or attached to plants or stones in quiet, fresh waters. Cape Nome, Alaska, *W.A.S.*!; Fidalgo Island, Wash., *N.L.G.*, No. 604!; Lake Washington, Seattle, Wash., *N.L.G.*, Nos. 352!, 570!

Tolypothrix lanata (Desv.) Wartmann.

Forming dark brown, felt-like layers on rocks or on the bottom of shallow fresh waters or dried streams. Iliuliuk, Alaska, *W.A.S. and A.A.L.*, No. 4050!, and in Collins, Holden and Setchell, P. B.-A., No. 956!; near Seattle, Wash., Professor *T. C. D. Kincaid*, No. 766!

All the specimens noted, represent the older stages with deep brown sheaths.

Tolypothrix tenuis Kuetzing.

Forming bluish green tufts in quiet or flowing fresh water. Popof Island, Alaska, *Saunders*, No. 404! (1901, p. 398); Glacier Bay, Alaska, *Saunders*, No. 300! (1901, p. 398); near Newhall, Orcas Island, Wash., *N.L.G.*, No. 616!; Green Lake, Seattle, Wash., *N.L.G.*, No. 562!.

Tolypothrix Setchellii Collins.

On Chara. Near Iliuliuk, Unalaska, Alaska, *A.A.L.*!

A dwarf species.

Tolypothrix limbata Thuret.

Growing on the side of a jar in the botanical laboratory of the University of Washington. Seattle, Wash., *N.L.G.*, No. 500!

The sheath in this specimen is very thick and is ocreate above.

Desmonema Wrangelii (Agardh) B. & F.

On stones in brooks or lakes, or even in pools on the tundra. St. Michael, Alaska, *W.A.S.*, No. 5157x!; near Iliuliuk, Unalaska, *W.A.S. and A.A.L.*, Nos. 4008!, 4044!; Popof Island, Alaska, *Saunders*, No. 404! (1901, p. 398); Glacier Bay, Alaska, *Saunders*, No. 103! (1901, p. 398).

Family STIGONEMATACEÆ.

Hapalosiphon fontinalis (Agardh) Bornet.

In a fresh water pond. Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 399, under *H. pumilus*).

Fischerella ambigua (Kuetzing) Gomont.

On vertical rocks, just above the high tide mark. Port Renfrew, B.C., *Tilden*, No. 398!, under *Hassallia byssoidea* f. *cylindrica* Tilden.

Although the basal stratum and fasciculi of branchlets are not well developed, yet the branches seem to indicate this species rather than the one to which Miss Tilden has referred it.

Stigonema ocellatum (Dillwyn) Thuret.

On rocks or floating, in quiet or running fresh water. Near

Prince William Sound, Alaska, *Saunders*, No. 300! (1901, p. 399); Glacier Bay, Alaska, *Saunders* (1901, p. 399).

Stigonema minutum (Agardh) Hassall.

On damp rocks. Prince William Sound, Alaska, *Saunders* (1901, p. 399).

FAMILY RIVULARIACEÆ.

Calothrix consociata (Kuetzing) B. & F.

On grasses, etc., in a salt marsh. Head of Penn's Cove, near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 548!

From its diameter and coloration of sheath, the number quoted above seems to belong here. The species seems to partake of the characters of both *C. confervicola* (Roth) Agardh and *C. scopulorum* (Weber et Mohr) Agardh, but with much wider sheaths than either species has according to description.

Calothrix scopulorum (Weber et Mohr) Agardh.

In salt water. Puget Sound, *Saunders* (1901, p. 399).

Calothrix pulvinata (Mertens) Agardh.

On sticks and old wood, in salt marshes. Whidbey Island, Wash., *N.L.G.*, Nos. 303!, 560!, and in Collins, Holden and Setchell, P. B.-A, No. 957!

Calothrix crustacea Thuret.

Floating, on rocks, clay banks, wood, etc., in brackish lagoon. Whidbey Island, Wash., *N.L.G.*, Nos. 302!, 421!, 583!; Keyport, Kitsap County, Wash., *N.L.G.*, No. 494!

This is a very variable species, especially concerning the matter of branching. While most of the filaments are simple and typical, there are intermingled, particularly in No. 583, filaments branched in such a way as to properly come under *C. prolifera* Flahault, *C. fasciculata* Agardh, and even *C. vivipara* Harvey. No. 494 grew on a clay bank above high water mark, and represents a very depauperate form of the species.

Calothrix fusca (Kuetzing) B. & F.

Occurring singly or few together in the jelly of other species of algæ. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*,

No. 4032!; Kadiak Island and Cook Inlet, Alaska, *Saunders* (1901, p. 399).

Calothrix parietina (Nægeli) Thuret.

Forming reddish brown patches on dripping rocks. Amaknak Cave, Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3294!

Calothrix Braunii B. & F.

On pebbles at edge of lake. Lake Union, Seattle, Wash., *Tilden*, No. 286b!

Miss Tilden has distributed two specimens under this name and number. No. 286a, growing on dead floating stems of Scirpus, has intercalary heterocysts and false branching. It seems to be a species of Tolypothrix. No. 286b seems to represent a form of *C. Braunii* with slender trichomes (4–5 μ in diameter) and sheaths becoming yellowish brown.

Dichothrix Baueriana (Grunow) B. & F.

On dripping rocks or stones in running or quiet water. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4043!; Orca, Alaska, *W. L. Jepson*, Nos. 5173x!, 5175!; Whatcom, Wash., *N.L.G.*, No. 608!

Isactis plana var. **fissurata** B. & F.

On stones. Captains Bay, Unalaska, Alaska, *A.A.L.*, No. 5013a!

Rivularia Biasolettiana Meneghini.

On dripping rocks, on roots, etc., in fresh or brackish water. West shore of Amaknak Island, Bay of Unalaska. Alaska, *W.A.S. and A.A.L.*, No. 4005!; at mouth of creek, Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4015!; Glacier Bay, Alaska, *Saunders*, No. 102! (1901, p. 399); Juneau, Alaska, *Saunders*, No. 76! (1901, p. 399); Port Renfrew, Vancouver Island, B.C., *Tilden*, Nos. 570!, 571! (the latter under *R. nitida*); East Sound, Orcas Island, Wash., *N.L.G.*, No. 496!

Rivularia nitida Agardh.

On mud near high water mark. St. Michael, Alaska, *W.A.S.* No. 5249x!

Gloiotrichia Pisum Thuret.

On leaves of Potamogeton, in ponds of fresh water. Whidbey Island, Wash., *N.L.G.*, Nos. 459! 463!; near Seattle, Wash., Professor *T. C. D. Kincaid*, No. 767!

The specimens are all young and there are no spores, but there is little doubt as to the determination of the species.

CHLOROPHYCEÆ.

We have used the name Chlorophyceæ, in the broad sense to include all those algæ which have no coloring matter in addition to the chlorophyll. This includes the group of the Conjugatæ, which differs so much from the others in cell structure and in the possession of non-motile gametes that it is generally separated. Similar opinions may be held as to some other families under the Chlorophyceæ, so that it seems best to reserve one term for all the grass-green algæ. In the treatment of this group, we have omitted all reference to the Desmidiaceæ, since from their number and the difficulties of study, they are not usually taken up by the general student. We have, in general, followed the classification proposed and carried out by Wille (1890–1891) in Engler and Prantl, departing from it only in some minor cases. For species, we have used for reference DeToni's account (1889), and such special papers as were particularly concerned in special cases and mentioned in the body of the text.

In the Chlorophyceæ we find that the majority of species are either cosmopolitan, or at least are common to the colder waters of the Northern Hemisphere. We have not constructed a table of species showing comparative distribution, since in the imperfection of our knowledge such a table would be more or less misleading. We find, however, that we know now that it is quite within the bounds of reason to expect to find any species of this group which occurs in the North Atlantic, also in the North Pacific. There are, probably, some species restricted to each district, but we are as yet very uncertain whether those which we now consider to be characteristic of the North Pacific, may not later be found also in the North Atlantic and the reverse.

Although acknowledgment has been made of the very great assistance given us by Mr. F. S. Collins, yet it should be emphasized again that he has made the determinations in the genera Chætomorpha, Cladophora, Enteromorpha, Monostroma, and Urospora, and also scattering determinations in some other genera. He has, beside this, kindly looked over our manuscript and has made corrections and suggestions of great value. In the discussion of the species of Cladophora, a field in which he has gained great proficiency, he has added some notes which will go a long way toward straightening out the confusion hitherto existing. Through him, also, Dr. T. E. Hazen has examined the greater part of our Ulothricaceæ and Chætophoraceæ, and aided us with determinations and critical notes.

FAMILY ZYGNEMACEÆ.

Zygnema chalybeospermum Hansgirg.

In waterfalls in a creek. Port Renfrew, B. C., *Tilden*, No. 392!

Miss Tilden says that the specimens do not agree with this species, but that the smooth median membrane of the zygote and the apparently scalariform conjugation bring it nearer to this than to any other. In our copy of the American Algæ, little is to be determined on account of the poor condition of the specimen distributed.

Spirogyra longata (Vaucher) Kuetzing.

Abundant in ditches of fresh, or even of slightly brackish water. Near LaConner, Wash., *N. L. G.*, No. 340!; Seattle, Wash., *N.L.G.*, Nos. 664!, 665!

Good fruiting material was gathered in May, and both lateral and scalariform conjugation was observed.

Spirogyra porticalis (Mueller) Cleve.

In running water. Popof Island, Alaska, *Saunders* (1901, p. 409).

Spirogyra catenæformis (Hassall) Kuetzing.

In a pond of slightly brackish water. Swantown, Whidbey Island, Wash., *N.L.G.*, No. 417!

This species is mixed with *Spirogyra Grevilleana* in this locality.

Spirogyra varians (Hassall) Kuetzing.

On dripping rocks and in ditches of fresh water. Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 409); Whidbey Island, Wash., *N.L.G.*, Nos. 233!, 666!, and in Collins, Holden and Setchell, P. B.-A., No. 962!; East Sound, Orcas Island, Wash., *N.L.G.*, No. 489!; Seattle, Wash., *N.L.G.*, No. 660!

The gatherings of this species show both lateral and scalariform conjugation.

Spirogyra nitida (Dillwyn) Link.

In fresh water. Near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 661!

Spirogyra majuscula Kuetzing.

In a ditch of fresh water. Near the University of Washington, Seattle, Wash., *N.L.G.*, No. 390!

Our specimens seem to belong to the type, but differ from the ordinary plants in having the fertile cells slightly swollen.

Spirogyra majuscula var. **brachymeres** Stiz.

On shore of Green Lake, near Seattle, Wash., *Tilden*, No. 285!

Miss Tilden's specimen, in our copy, shows only the preliminary stages of conjugation and leaves the species in doubt.

Spirogyra affinis (Hassall) Petit.

In fresh water stream. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5032!, and in Collins, Holden and Setchell, P. B.-A., No. 959!

Spirogyra Lutetiana Petit.

Floating in a ditch of fresh water. Ravenna Park, Seattle, Wash., *N.L.G.*, No. 402!

Spirogyra dubia var. **longiarticulata** Kuetzing.

Pond of fresh water. Near Victoria, B. C., *N.L.G.*, No. 316!, and in Collins, Holden and Setchell, P. B.-A., No. 961!

Spirogyra inflata (Vaucher) Rabenhorst.

In a ditch of fresh water. Near Seattle, Wash., *N.L.G.*, Nos. 389!, 659!

Spirogyra Spreeiana Rabenhorst.

Floating in a pond of fresh water. Penn's Cove, Whidbey Island, Wash., *N.L.G.*, No. 629!

Spirogyra Weberi Kuetzing.

Fresh water. Seattle, Wash., *N.L.G.*, No. 663!

The specimens are not quite typical *Spirogyra Weberi*, but are intermediate between that species and *Spirogyra quadrata* (Hassall) Petit.

Spirogyra Grevilleana (Hassall) Kuetzing.

In a pond of slightly brackish water. Swantown, Whidbey Island, Wash., *N.L.G.*, No. 417!

Mixed, in the locality mentioned, with *Spirogyra catenæformis*.

Spirogyra laxa Kuetzing.

In a small pond of fresh water. Whidbey Island, Wash., *N.L.G.*, No. 420!

FAMILY MESOCARPACEÆ.

Mougeotia scalaris Hassall.

In a ditch by the roadside. Orcas Island, Wash., *N.L.G.*, No. 473!

Mougeotia genuflexa (Dillwyn) Agardh.

In pools and ditches of fresh water. Victoria, B. C., *N.L.G.*, No. 314!; Orcas Island, Wash., *N.L.G.*, Nos. 473!, 481!; Seattle, Wash., *N.L.G.*, Nos. 630!, 662!

All the specimens are in good fruit and collected either in May or July. In No. 481, both lateral and scalariform conjugation occurs.

FAMILY VOLVOCACEÆ.

Chlamydomonas sp.

Under this genus are to be placed the several forms, or at least some of them, which were at one time placed under the genus Glœocystis. Here comes then, temporarily, *Gloeocystis Paro-*

liniana (Meneghini) Nægeli which formed soft gelatinous masses of the color of prune jelly on cliffs near Iliuliuk, Unalaska, Alaska (*W.A.S. and A.A.L.*, No. 4032!) and two others, not readily placed, viz., one forming yellow green soft gelatinous patches on mosses at Sitka, Alaska (*W.A.S. and A.A.L.*, No. 5206!) and the other found on a dripping water pipe at Seattle, Wash., (*N.L.G.*, No. 394!).

Sphærella nivalis (Bauer) Sommerfelt.

On banks of snow and where snow is melting. Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4048!; Yakutat Bay, Alaska, *Saunders* (1901, p. 409).

The so-called red snow is not uncommon in the mountains and even along the shores of the territory included in this paper, but no careful study has been made as to the presence of this species in one or another form. It has seemed best, therefore, to report only these two localities which are represented by actual specimens of the algæ concerned.

Eudorina elegans Ehrenberg.

Mixed with various confervoid species. Bog Lake, west side of Whidbey Island, Wash., *N.L.G.*, No. 456!

Volvox aureus Ehrenberg.

Intermingled with Spirogyra filaments. Near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 661!

The material of this species was placed in formalin solution and could not be studied in the living condition. The colonies measure about 200 μ in diameter and the cells are 4–6 μ broad. Consequently, the specimens have been referred to this species rather than to *V. globator* (L.) Ehrenberg.

FAMILY TETRASPORACEÆ.

Tetraspora bullosa (Roth) Agardh.

In small ditches of running fresh water. Seattle, Wash., *N.L.G.*, Nos. 381!, 388!

Tetraspora cylindrica (Wahlenb.) Agardh.

In rapidly flowing mountain stream. Silver Bow Basin, Juneau, Alaska, *W. L. Jepson*, Nos. 5200!, 5201!, and in Collins, Holden and Setchell, P. B.-A., No. 908!

Decidedly firmer in texture than the preceding and provided with a distinct stipe, but it hardly seems either necessary or proper to remove it to another genus as Chodat has proposed in creating his Stapfia (1897, p. 947). The possession of a solid gelatinous axis is also a character of the proposed genus Stapfia, but hardly characterizes it sufficiently. Nordstedt (1899, p. 267) has discussed the nature of the genus and the identity of *Stapfia cylindrica* Chodat and *Ulva cylindrica* Wahlenb., while Börgesen (1898, p, 135) has described and figured the stipe.

Tetraspora lubrica var. **lacunosa** Chauv.

In small brooks. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4094!; Port Renfrew, Vancouver Island, B. C., *Butler and Polley*, and in Collins, Holden and Setchell, P. B.-A., No. 861!

COLLINSIELLA Setchell and Gardner gen. nov. Tetrasporacearum.

Fronds globular to irregularly and tuberculately lobed, confluent by a thin basal layer, at first solid, later hollow, composed throughout of pear-shaped cells on dichotomously branched, gelatinous stalks which taper downwards. Chromatophore single, band-shaped, with a single conspicuous pyrenoid.

The genus, here proposed, is most nearly related to Oocardium, but differs from it in the shape of the cells, in the presence of cells throughout the jelly of the frond, and the shape of the gelatinous stalks of the cells. We take pleasure in dedicating this genus to our friend, Frank Shipley Collins of Malden, Mass., in recognition of his services to American Algology.

Collinsiella tuberculata Setchell and Gardner sp. nov.
PLATE 17.

Forming extended layers of a dark green color and firmly gelatinous consistency on stones and pebbles. Cells piriform, 12–20 μ by 9–12 μ. The branching proceeds from division in two directions at right angles to one another and to the sur-

face of the frond. Only one of these resulting cells divides again, the other remains in position and undivided. From this, it happens that the cells are not all in a peripheral layer as Nægeli (1849, p. 74, pl. III, A.) has described for his *Oocardium stratum*, but are scattered throughout the frond as shown in our figure. The stalks of the cells, also, are different from those of the species just referred to, in that they taper downwards. The stalks take on a deep blue color immediately upon being treated with Chloriodide of Zinc.

On stones and pebbles in a shallow pool, middle litoral zone, in a single locality much exposed to heavy seas, on the west coast of Whidbey Island., Wash., *N.L.G.*, No. 403!, and in Collins, Holden and Setchell, P. B.-A., No. 909! A few specimens of this species have also been collected at the Farallones, near San Francisco, California, by R. A. Harper and W. J. V. Osterhout.

Family PLEUROCOCCACEÆ.

Schizochlamys gelatinosa A. Braun.

Forming light green, lobulated masses at the bottom of a small pond of fresh water. Amaknak Island, Alaska, *W.A.S. and A.A.L.*, No. 5046a!

Oocystis solitaria f. **major** Wille.

On rocks, dripping with fresh water. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4028!

The plant referred to this form of the species measures somewhat less than the dimensions given, but is decidedly larger than the typical form.

Oocystis solitaria f. **crassa** (Wittrock) Hansgirg.

Forming a mucous coating on damp rocks near waterfalls. Juneau, Alaska, *Saunders*, No. 75! (1901, p. 409).

Selenastrum Bibraianum Reinsch.

Among weeds in ponds of fresh water. Near Seattle, Wash., Professor *T. C. D. Kincaid*, No. 768!

There is an abundance of material of this species in the specimen quoted.

Scenedesmus denticulatus var. **linearis** Hansgirg.

Mixed with other algæ in a pond of slightly brackish water. Near Swantown, Whidbey Island, Wash., *N.L.G.*, No. 417!

Urococcus insignis Hassall.

Intermixed with other algæ on sods of deserted hut, Cape Nome, Alaska, *W.A.S.*!; intermixed with other algæ on dripping rocks, Esquimalt, B. C., *N.L.G.*, No. 327!

All stages of this interesting but puzzling organism were found in the collections, from thin-walled cells with green contents, to very thick-walled cells with golden yellow contents.

FAMILY PROTOCOCCACEÆ.

Chlorochytrium inclusum Kjellman.

Endophytic in the fronds of various membranaceous red algæ. In the fronds of *Iridæa laminarioides* Bory, Unga, Alaska, *A.A.L.*, No. 5050!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 290!; in the fronds of *Callymenia Phyllophora* J. Agardh, Harvester Island, Uyak Bay, Kadiak Island, *W.A.S. and A.A.L.*, No. 5119!; Unga, Alaska, *A.A.L.*, No. 5055!; in the fronds of *Constantinea Sitchensis* P. & R., Esquimalt, B. C., *Tilden*, No. 389!; in the fronds of *Sarcophyllis Californica* J. Agardh, *N.L.G.*, in Collins, Holden and Setchell, P. B.-A., No. 514!

This plant is probably very common and careful examination will probably show it endophytic on other species of red algæ from other localities, but enough is recorded to give reason for believing that it is by no means uncommon in the region under discussion. It extends down to Monterey on the coast of California and perhaps even farther southward. The form growing on Constantinea has been investigated and reported upon by E. M. Freeman (1899) who decides that it is a true Chlorochytrium and very probably *Ch. inclusum* Kjellman.

Chlorochytrium Schmitzii Rosenvinge.

In fronds of *Petrocelis Middendorfii* (Ruprecht) Kjellman, growing in the upper litoral zone. Harvester Island, Uyak Bay,

Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5124!; lower litoral zone, west coast of Whidbey Island, Wash., *N.L.G.*!

The plants referred under this species agree very well with the description and figure of Rosenvinge, except that some have apical papillæ. Some of them do not have these and agree in this with the original description.

Family HYDRODICTYACEÆ.

Pediastrum Boryanum (Turpin) Meneghini.

Intermixed with other algæ of fresh water pools. Point Barrow, Alaska, *Farlow* (1885, p. 192); Popof Island, Alaska, *Saunders*, (1901, p. 409).

Pediastrum angulosum (Ehrenberg) Meneghini.

Intermixed with other algæ in shallow pools and ponds of fresh water. Glacier Valley, Island of Unalaska, Alaska, *A.A.L.*, No. 5023a!; Popof Island, Alaska, *Saunders* (1901, p. 409).

Sorastrum spinulosum Nægeli.

Among water weeds in ponds of fresh water. Near Seattle, Wash., Professor *T. C. D. Kincaid*, No. 768!

Very scanty, but of undoubted occurrence in the specimen quoted.

Family ULVACEÆ.

Monostroma lubricum Kjellman.

Sitka, Alaska, *Ida M. Rodgers*, No. 5722!

Monostroma latissimum (Kuetzing) Wittrock.

On stones and mussels, lower litoral zone, in more or less brackish water. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No.4020!; on Fucus, litoral zone, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5077! (a younger form); in brackish pools, near LaConner, Skagit County, Wash., *N.L.G.*, No. 567!

Monostroma quaternarium (Kuetzing) Desmazieres.

West coast of Whidbey Island, Wash., *N.L.G.*, No. 187!

Monostroma Grevillei (Thuret) Wittrock.

On stones, just above and just below extreme low water mark. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4016a!

Mr. Collins in his report on the collections says "*Monostroma Grevillei*, probably". The species is also taken in a sense somewhat narrower than that of Rosenvinge (1893, p. 948, *et seq.*), at least not including *M. arcticum* nor *M. Vahlii* (cf. also Rosenvinge, 1894, pp. 149–155, and 1898, p. 117.)

Monostroma arcticum Wittrock.

On stones in shallow pools of the middle litoral zone. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3260!, and in Collins, Holden and Setchell, P. B.-A., No. 910!; Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5071!

Mr. Collins takes *M. arcticum* in a sense broad enough to include *M. angicavum* Kjellman and *M. saccodeum* Kjellman, but prefers to keep *M. arcticum*, itself, as a distinct species, and not unite it with *M. Grevillei* Wittrock as Rosenvinge has done (cf. Rosenvinge, 1893, p. 946, and 1894, p. 152).

Monstroma Grœnlandicum J. Agardh.

On small boulders, middle litoral zone. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3278!, 3299!; Kukak Bay, Alaska, *Saunders* (1901, p. 410).

Monostroma Vahlii J. Agardh.

Kukak Bay, Alaska, *Saunders* (1901, p. 410).

Monostroma fuscum (P. & R.) Wittrock.

On stones in the middle litoral zone. North Pacific Ocean, *Postels and Ruprecht* (1840, p. 21, under *Ulva fusca*); Kukak Bay and Virgin Bay, Alaska, *Saunders* (1901, p. 409); Orca. Alaska, *W.A.S. and A.A.L.*, No. 5159!; Muir Inlet of Glacier Bay and Sitka, Alaska, *Saunders*, (1901, p. 409); floating in slightly brackish water, Crocket's Lake, Whidbey Island, Wash., *N.L.G.*, No. 531!

Mr. Collins takes this species in the later and broader sense to include also *M. splendens* (Ruprecht) Wittrock and *M. Blyttii* (Areschoug) Wittrock. All the above specimens which have

been examined belong to Rosenvinge's var. *typica*. No. 531 is the form known as *M. Blyttii*.

Monostroma fuscum var. splendens (Ruprecht) Rosenvinge.

On stones in the middle litoral zone. St. Paul Island, Alaska, *Townsend*, No. 5785!, *Greeley and Snodgrass*, No. 5800! (cf. Setchell, 1899, under *M. splendens*); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3261!, and in Collins, Holden and Setchell, P. B.-A., No. 911!; Pinnacles, near Summer Bay, Unalaska, Alaska, *A.A.L.*, No. 4097!; Lowe Inlet, Alaska, *Saunders* (1901, p. 409, under *M. splendens*). The variety, which is the original *Ulva* or *Ulvaria splendens* Ruprecht, is to be distinguished from the var. *typica*, according to Rosenvinge, by the thickened external wall.

Monostroma leptodermum Kjellman.

Forming a dense growth on Zostera, in shallow water. Between Brown and San Juan Islands, Wash., *Tilden*, No. 388!, under *Monostroma zostericolum*.

Mr. Collins reports that this is the same plant as found growing on the New England coast and listed by him (1900, p. 44), and that it agrees in all respects with the description and figures of Kjellman (1877, p. 52, fig. 23, 24). Rosenvinge (1893, p. 944 and 1894, p. 149), however, figures a plant under Kjellman's name which has a long tubular stipe which is lacking in the New England specimens, and also in the specimens of Miss Tilden. Kjellman's plants lacked the base. The question is, whether the plant of Rosenvinge or our plant is the plant of Kjellman. Mr. Collins prefers to believe that our plants are *M. leptodermum* and that Rosenvinge's belong to another and probably to a new species.

Ulva Lactuca var. rigida (Agardh) LeJolis.

In various situations. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 53, under *U. rigida*); Pathfinder Rock, Norton Sound, Alaska, *R. C. McGregor*, No. 5680!; St. Michael, Alaska, *W.A.S.*, No. 5237x!, 5245y!; Shumagin Islands, Alaska, *Saunders* (1901, p. 410); Harvester Island, Uyak Bay, Alaska, *W.A.S. and A.A.L.*, No. 5116!; Virgin Bay, Prince William

Sound, Alaska, *Saunders* (1901, p. 410); Sitka, Alaska, *Ida M. Rodgers*, No. 5723!; Port Renfrew, B. C., *Butler and Polley*, No. 14; Esquimalt, B. C., *Harvey* (1862, p. 176); Idlewild, San Juan Island, Wash., *Tilden*, Nos. 386!, 387!; Tracyton, Kitsap County, Wash., *Tilden*, No. 260!

Ulva Lactuca var. **latissima** (L.) LeJolis.

Generally floating when mature, but in the earlier stages attached to rock or wood, usually in muddy situations. Pinnacles, Summer Bay, Unalaska, Alaska, *A.A.L.*, No. 4097a!; Sitka, Alaska, *Saunders* (1901, p. 410, under *U. Lactuca myriotrema*); Norfolk Sound (near Sitka), Alaska, *Postels and Ruprecht* (1840, p. 21); Puget Sound, *Bailey and Harvey*, (1862, p. 163); Esquimalt, B. C., *Harvey*, (1862, p. 176); Whidbey Island, Wash., *N.L.G.*, No. 112!; East Sound, Orcas Island, Wash., *N.L.G.*, No. 529!; Friday Harbor and Roach Harbor, San Juan Island, Wash., *N.L.G.*, No. 667!

It is difficult to determine just what course to take with the various specimens of Ulva which we have from the region included under this account. A very considerable study of the species of Ulva along the entire western coast of North America indicates that, while there may be many forms, there is probably only one species and very few varieties. The habit, size, color, and even the character of cell depends so much on the age and the environment of the specimen, that it is possible to trace a series from the quiet water inside a point of land to the exposed localities outside of it which may include all the forms and intermediate conditions between the most distinct species as yet proposed under the genus. We have, therefore, arranged the forms of the Northwest Coast under two varieties of one species. Var. *rigida* includes all the specimens which are lanceolate in general outline, while var. *latissima* includes all those which show a tendency to be shorter than broad, and are of general expanded habit at maturity. Under each of these varieties, there are numerous forms to be mentioned, due to less conspicuous conditions of growth, but we have decided not to attempt a separation of these in this paper. Nos. 260 and 387 of Miss Tilden's American Algæ are conspicuous on account of the long stipes which give them the appearance

of *Enteromorpha Linza.* No. 667 of N. L. Gardner covered the quiet bays, lying on the muddy bottom, or floating in expanded fronds two or three meters square. Young plants were found just starting on the warm mud. In using the names of Le Jolis, the writers desire to have it understood that they do not accept all of the synonymy of that writer. The *Ulva fasciata* of Harvey's List (1862, p. 176) is unknown to us, but we presume that it is only a narrow form of var. *rigida.*

Enteromorpha micrococca Kuetzing.

On rocks, upper or middle litoral zone. Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4054a!; Dutch Harbor, Amaknak Island, Bay of Unalaska, Alaska, *R. C. McGregor*, No. 5695!; Shumagin Islands and Orca, Alaska, *Saunders* (1901. p. 411).

Enteromorpha micrococca f. subsalsa Kjellman.

On dripping rocks above high water mark. Chuckanut Quarry, near Fairhaven, Wash., *N.L.G.*, No. 228!

Enteromorpha fascia P. & R.

In the North Pacific Ocean between Asia and America, *Postels and Ruprecht* (1840, p. 21).

We know nothing of this species beyond the information in Postels and Ruprecht just cited, and such additional facts as are presented by J. G. Agardh in his revision of the Ulvaceæ (1882, p. 125) where the opinion is expressed that it is very near to *E. compressa* (L.) Grev., but differs from that species in having a light brown color. Mr. Collins reports that he has examined the specimen labelled *Enteromorpha fascia*, under No. 1052 of Wittrock and Nordstedt, and finds it different from any species of the genus which he has seen before.

Enteromorpha prolifera (Mueller) J. Agardh.

Usually found floating or cast ashore. Golofnin Bay, Alaska, *R. C. McGregor*, No. 5687!; Juneau, Alaska, *W.A.S. and A.A.L.*, No. 5195!; Annette Island, Alaska, *Saunders* (1901, p. 411); near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 210!, and in Collins, Holden and Setchell, P. B.-A., No. 913!; Tracyton, Kitsap County, Wash., *Tilden*, Nos. 385!, 264! (under *E. com-*

pressa var. *subsimplex*), 265! (under *E. compressa* var. *complanata*).

Enteromorpha intestinalis (L.) Link.

In all sorts of localities in the upper litoral zone and in the brackish waters of mud flats and ditches in salt marshes. Metlakatla, Annette Island, Alaska, *Saunders* (1901, p. 411); Straits of Georgia, *Harvey* (1862, p. 176); Port Renfrew, B. C., *Butler and Polley*, Nos. 29, 42; Whidbey Island, Wash., *N. L. G.*, Nos. 167!, 229!, 518!, 519!, 532!; East Sound, Orcas Island, Wash., *N.L.G.*, No. 568!

This usually very common and somewhat variable species was not detected in the upper portions of our territory, although many localities seemed favorable for its growth. There has been no attempt to segregate the numbers given above into forms. Three forms have been separated, however, by others and are quoted below.

Enteromorpha intestinalis f. genuina Hauck.

On the beach at Tracyton, Kitsap County, Wash., *Tilden*, No. 263!

Mr. Collins notes (in lit.) that this plant is not exactly like No. 323 of the Phykotheka Universalis, but is fairly near it.

Enteromorpha intestinalis f. cylindracea J. Agardh.

Saunders notes this form (1901, p. 411) from Sand Point, Popof Island, and from Kukak Bay, Alaska.

Enteromorpha intestinalis f. maxima J. Agardh.

Saunders notes this form (1901, p. 411) from Kukak Bay and Orca in Alaska and from Victoria, B. C.

Enteromorpha Linza (L.) J. Agardh.

Attached to stones in the litoral zone. North Pacific Ocean, *Postels and Ruprecht* (1840, p. 21); Esquimalt, B. C., and Orcas Island, Wash., *Harvey* (1862, p. 176); Victoria, B. C., *Tilden*, No. 384!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, Nos. 168!, 213!

Enteromorpha Linza f. lanceolata J. Agardh.

Similar places. Orca, Alaska, *W.A.S. and A.A.L.*, No. 5161!; Yakutat Bay, Alaska, *Saunders* (1901, p. 411), *Rev. Albin Johnson*, No. 5702!, and in Collins, Holden and Setchell, P. B.-A., No. 967b!; Whidbey Island, Wash., *N.L.G.*!

Some, if not all, of the numbers given under the species are of this form, while of the second form only one reference is known to us as given below.

Enteromorpha Linza f. crispata J. Agardh.

Sitka, Alaska, *Saunders* (1901, p. 411).

Enteromorpha minima Nægeli.

Forming yellowish green silky tufts and patches in the upper and middle litoral zones. West shore of Amaknak Island, Unalaska Bay, Alaska, *W.A.S. and A.A.L.*, No. 3280!; Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4041!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5097!; Orca, Alaska, *W.A.S. and A.A.L.*, No. 5197!; Port Renfrew, B. C., *Butler and Polley*!; San Juan Island, Wash., *N.L.G.*, No. 217!, and in Collins, Holden and Setchell, P. B.-A., No. 912!

Enteromorpha minima f. rivularis Collins.

In running fresh water of Iliuliuk Creek, forming elongated, yellow, much entangled masses. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5043!, and in Collins, Holden and Setchell, P. B.-A., No. XXVI!

"From typical *E. minima* Naeg., distributed as P. B.-A., No. 468b, this form differs by the lighter color, greater length of filaments, more gelatinous substance, and by its occurrence in fresh water." Collins, P. B.-A., 1901c, No. XXVI.

Enteromorpha compressa (L.) Greville.

On rocks, stones, and other algæ, mostly in the upper and middle litoral zones. Golofnin Bay, Alaska, *R. C. McGregor*, Nos. 5666! and 5667!; Pathfinder Rock, Norton Sound, Alaska, *R. C. McGregor*, No. 5685!; Besboro Island, Norton Sound, Alaska, *R. C. McGregor*, Nos. 5663!, 5682!; St. Michael, Alaska, *W.A.S.*, Nos. 5240x!, 5250x!; North Pacific Ocean, *Postels and Ruprecht* (1840, p. 21); Bay of Unalaska, Alaska, *W.A.S. and*

A.A.L., No. 4063!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5107!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5139!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5713!; Juneau, Alaska, *W.A.S. and A.A.L.*, Nos. 5187!, 5193!; Esquimalt, B. C., *Harvey* (1862, p. 176); Puget Sound, *Bailey and Harvey* (1862, p. 163); Snakalum Point, Whidbey Island, Wash., *N.L.G.*, No. 197!

Enteromorpha compressa f. racemosa *a* Ahlneri Kjellman.

Enteromorpha compressa f. racemosa *b* abbreviata Kjellman.

St. Lawrence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 52).

Enteromorpha crinita (Roth) J. Agardh.

Attached to rocks or floating, in muddy places. St. Michael, Alaska, *W.A.S.*, No. 5250x!; Prince William Sound, Alaska, *Saunders* (1901, p. 412); Valdes, Alaska, *W.A.S. and A.A.L.*, Nos. 5184!, 5185!; Sitka, Alaska, *Saunders* (1901, p. 412), *W.A.S. and A.A.L.*, Nos. 5203a!, 5207a!, and in Collins, Holden and Setchell, P. B.-A., No. 965!; Wrangell, Alaska, *Saunders* (1901, p. 412.)

Mr. Collins notes that No. 5203a is too near to *E. erecta* (Lyngbye) J. Agardh.

Enteromorpha percursa (Agardh) J. Agardh.

In brackish pools and in salt marshes, usually entangled with other filamentous Chlorophyceæ. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4003!, and in Collins, Holden and Setchell, P. B.-A, No. 968!; Whidbey Island, Wash., *N.L.G.*, Nos. 301!, 414!, 415!

Enteromorpha aureola (Agardh) Kuetzing.

On rocks covered with slight layer of mud. St. Michael, Alaska, *W.A.S.*, No. 5241x!

The plant referred here, is mixed with *Rhizoclonium riparium* var. *implexum*.

Prasiola crispa (Lightfoot) Agardh.

On turf of old barrabbas, on tussocks in the tundra, on damp ground, etc. Cape Nome, Alaska, *W.A.S*!; St. Michael, Alaska,

L. M. Turner, No. 849 (Herb. U. S. National Museum)!, *W.A.S.*, Nos. 5235!, 5243x!, and in Collins, Holden and Setchell, P. B.-A., No. 969!, under *Hormidium parietinum*; St. Paul Island, Alaska, *B. W. Everman*! (Setchell, 1889, p. 590); Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4010!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5137!, *Saunders* (1901, p. 412, under *Hormidium parietinum*); Orca, Alaska, *W.A.S. and A.A.L.*, Nos. 5182!, 5183!; Yakutat Bay, Alaska, *Saunders* (1901, p. 412); Juneau, Alaska, *W.A.S. and A.A.L.*, Nos. 5191!, 5192!; Departure Bay, Vancouver Island, B. C., *W.A.S. and A.A.L.*, No. 5211!; Coupeville, Whidbey Island, Wash., *N.L.G.*, 669!

The specimens quoted above include all sorts of conditions from the typical *P. crispa* with its broad flat frond, to filamentous forms referable to *Hormidium parietinum* (Vaucher) Kuetzing or even to *H. murale* (Lyngbye) Kuetzing. In the majority of cases, these forms are mixed in the same collection and often show more or less perfect transitions from the one to the other.

Prasiola calophylla (Carmichael) Meneghini.

In brackish water at the head of Penn's Cove, Whidbey Island, Wash., *N.L.G.*, No. 258!

This narrow species contrasts very decidedly with *P. crispa* as well as with the next two species in the shape of the frond and the arrangement of the cells. We have been unable to compare it with authentic specimens but it answers to the descriptions and the figures so exactly that we feel little doubt concerning it.

Prasiola borealis Reed.

On rocks, just above high water mark. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 4013!, 4021!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5138!

This species comes nearest to *P. Antarctica* Kuetzing, but differs from it in shape and color of the fronds and in the less regular tetrad arrangement of the cells. The specimens of *P. borealis* are infested with a fungus (*Guignardia Alaskana* Reed) just as the Antarctic species is with *Guignardia Prasiolæ* (Winter) Reed, which gave rise to the genera *Mastodia* Hooker and Harvey and *Dermatomeris* Reinsch. For further details

consult Miss Reed's paper on the subject (Univ. of Calif. Publications, Botany, Vol. 1).

Prasiola fluviatilis (Sommerfelt) Areschoug.

Point Barrow, Alaska, *Farlow* (1885, p. 192)!

This is what Farlow refers doubtfully to *P. crispa* in the reference cited above. A specimen from Herb. Farlow in the U. S. National Herbarium is labelled *P. crispa* f. *maxima*?, but a specimen sent to us from Herb. Farlow, labelled as above, seems to us properly referred.

FAMILY ULOTHRICHACEÆ.

Ulothrix subtilis Kuetzing.

In slightly brackish water, Victoria, B. C., *N.L.G.*, No. 338!; in fresh water, LaConner, Skagit County, Wash., *N.L.G.*, No. 315!

The determination of these specimens is not absolutely certain, but they seem to belong to the typical form (f. *genuina* Kirchner) of this species.

Ulothrix zonata (Weber et Mohr) Kuetzing.

Forming yellowish green, almost gelatinous patches on rocks wet with abundant spray. Cascade near Iliuiiuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4046!, 5033!

The plants listed under this species were most beautiful in their growth and came from the very same spot, the earlier number having been collected on June 30, 1899, and the later number on August 10, 1889.

The determination was made by T. E. Hazen through the kindness of Mr. Collins.

Ulothrix tenuis Kuetzing.

Among the roots and leaves of grasses, slightly inundated, side of a rill. Near Iliuliuk, Unalaska, *W.A.S. and A.A.L.*, No. 5012a!

Determined by T. E. Hazen, through the kindness of Mr. Collins.

Ulothrix implexa Kuetzing.

Forming more or less expanded layers in localities near the mouths of small streams where the water is brackish, or, at times, nearly fresh. On piles of a wharf, Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4017!; on Fucus, Orca, Alaska, *W.A.S. and A.A.L.*, No. 5180!

Determined by T. E. Hazen, through the kindness of Mr. Collins.

Ulothrix flacca (Engl. Bot.) Thuret.

On rocks, pebbles, old wood, etc. St. Michael, Alaska, *W.A.S.*, No. 5251x!; Glacier Bay, *Saunders*, (1901, p. 412); Fairhaven, Wash., *N.L.G.*, No. 194!

The determinations are all by Mr. Collins.

Gayella polyrhiza Rosenvinge.

On small boulders, well up in the litoral zone. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3279a!, and in Collins, Holden and Setchell, P. B.-A., 914!

This seems to be the only locality for this species discovered outside of those on the west coast of Greenland and the Færöes. Börgesen (1902, p. 482) refers this species to *Prasiola crispa* as subsp. *marina*. (det. F. S. Collins.)

Hormidium sp.

Species formerly referred to this genus, especially *H. parietinum* (Vaucher) Kuetzing, have been found either pure or associated with Prasiola-forms in different stages of development. We have referred them all under Prasiola.

Microspora floccosa (Vaucher) Thuret.

In pools above high water mark, Esquimalt, B. C., *Harvey* (1862, p. 177, under *Conferva floccosa*); in creek, Port Renfrew, B. C., *Tilden*, No. 139b!

Conferva bombycina (Agardh) Lagerheim.

Forming silky, yellow, gelatinous masses on dripping rocks. Amaknak Cave on the west shore of Amaknak Island, Alaska,

W.A.S. and A.A.L., No. 3297! (det. T. E. Hazen); on dripping rock cliff, Esquimault, B. C., *N.L.G.*, No. 327! (probably f. *genuina*).

"**Conferva rivularis** Ag."

Sumas Prairie, B. C., *Harvey* (1862, p. 177).

We have no knowledge or suspicion as to the identity of this plant.

FAMILY CHÆTOPHORACEÆ.

Stigeoclonium lubricum (Dillwyn) Kuetzing.

In light yellow tufts on grasses, in a small, slow stream in the tundra above the lake. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5035! (det. T. E. Hazen).

Draparnaldia glomerata (Vaucher) Agardh.

In small brook, Huntville, Island of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4094!; on damp rocks above tide, Ludlow Bay, Jefferson County, Wash., *N.L.G.*, No. 554!

Draparnaldia glomerata var. **genuina** Kirchner.

In cold water stream. Hazeldene Creek, Port Renfrew, Vancouver Island, B. C., *Tilden*, No. 383!

Draparnaldia plumosa (Vaucher) Agardh.

Growing on pebbles along the shore of Green Lake, Seattle, Wash., *N.L.G.*, No. 498! (det. T. E. Hazen).

Chætophora pisiformis (Roth) Agardh.

Attached to weeds, grass, dead stems, sticks, etc., in springs and pools of fresh water. Near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 461!; Green Lake, Seattle, Wash., *N.L.G.*, No. 478!; Seattle, Wash., *N.L.G.*, No. 386!

Chætophora elegans (Roth) Agardh.

In ponds of fresh water. Near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 461!; Port Townsend, Wash., *N.L.G.*, No. 434!

Chætophora Cornu-Damæ var. **genuina** De Toni.

On sticks, sedges, and grasses, in pool of fresh water. East Sound, Orcas Island, Wash., *N.L.G.*, Nos. 484!, 497!

Chætophora Cornu-Damæ var. **linearis** Kuetzing.

South end of Lake Washington, near Renton, King County, Wash., *Tilden*, No. 267!

Ochlochæte Hystrix Thwaites.

On water weeds in ponds of fresh water. Near Seattle, Wash., Professor *T. C. D. Kincaid*, No. 768!

Trentepohlia Iolithus (L.) Wallroth.

On rocks at 1000 feet elevation. Orca, Alaska, *Saunders* (1901, p. 413).

FAMILY MYCOIDEACEÆ.

Pringsheimia scutata f. **Cladophoræ** Tilden.

On Cladophora in tide pool. Port Renfrew, B. C., *Tilden*, No. 382!

We have examined the specimen distributed by Miss Tilden in our copy of the American Algae and find an epiphyte which, while bearing a certain superficial resemblance to *Pringsheimia scutata* Reinke, structurally shows itself clearly a member of the Chamæsiphoniaceæ and probably identical with Wille's *Chloroglœa tuberculosa*, under which name it has been mentioned in its proper sequence in this account. We feel that Miss Tilden's name is fairly properly to be placed as a synonym under Wille's.

FAMILY ŒDOGONIACEÆ.

We have found no species of this family, ourselves, and can only quote those enumerated by Miss Tilden and by Saunders, the determinations of all of which are by Karl E. Hirn.

Œdogonium concatenatum (Hassall) Wittrock.

Popof Island, Alaska, *Saunders* (1901, p. 412).

Œdogonium crispum (Hassall) Wittrock.

In pools, on rocks, just above high water mark. Port Renfrew, B. C, *Tilden*, No. 543!

Bulbochæte Brebissonii Kuetzing.

In a fresh water pond. Near Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 412).

Bulbochæte intermedia De Bary.

In a fresh water pond. Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 412).

Bulbochæte Nordstedtii Wittrock.

In a fresh water pond. Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 413).

Bulbochæte nana Wittrock.

In a fresh water pond. Shumagin Islands, Alaska, *Saunders* (1901, p. 413).

Bulbochæte insignis Pringsheim.

Saunders (1901, p, 413) gives this species in his Alaskan Algæ, but does not mention any special locality.

FAMILY COLEOCHÆTACEÆ.

Coleochæte pulvinata A. Braun.

In a glacial pool, growing on Chara. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5039!

FAMILY CLADOPHORACEÆ.

Urospora penicilliformis (Roth) Areschoug.

On rocks, in the litoral zone, sometimes higher up and sometimes very low down. Port Clarence, Alaska, *Kjellman* (1889, p. 55); St. Michael, Alaska, *W.A.S.*, No. 5251!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3279!; Kukak Bay, Alaska, *Saunders* (1901, p. 413); Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 177, under *Hormotrichum Carmichaelii*); Port Renfrew, B. C., *Butler and Polley*, No. 125; Esquimalt, B.C., *N.L.G.*, No. 514!; west shore of Whidbey Island, Wash., *N.L.G.*, No. 515!

Urospora incrassata Kjellman.

On rocks in the litoral zone. Whidbey Island, Wash., *N.L.G.*, No. 185!

The material seems to Mr. Collins to be of this species.

Urospora Wormskioldii (Mertens) Rosenvinge.

On small stones on exposed coasts. Near Victoria, B. C. *Tilden*, No. 381!; west shore of Whidbey Island, Wash., *N.L.G.*, Nos. 671!, 234!, and in Collins, Holden and Setchell, P. B.-A. No. 915!: San Juan Island, Wash., *N.L.G.*, No. 208!

Mr. Collins expresses the opinion that Miss Tilden's specimens are too near the type to be separated under the varietal name *Vancouveriana* as she has done, and that Gardner's San Juan Island specimens represent a rather slender form.

Chætomorpha cannabina (Areschoug) Kjellman.

Lying loose or entangled among other algæ, in pools, litoral zone. Norton Sound, Alaska, *R. C. McGregor*, No. 5686!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3244!, and in Collins, Holden and Setchell P. B.-A., No. 916!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5141!; Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 413); Orca, Alaska, *W.A.S. and A.A.L.*, No. 5169!; Annette Island, Alaska, *Saunders* (1901, p. 413); Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 219!

Chætomorpha duriuscula (Ruprecht) De Toni.

Unalaska, Alaska, *Ruprecht* (1851, p. 404).

De Toni (1889, p. 277) refers the *Conferva duriuscula* of Ruprecht to the genus Chætomorpha with more or less doubt. We have not seen any plants attributed to this, but judging from the description and the association, it is more likely to be some fragmentary material of Cladophora, upon which the species was founded.

Chætomorpha litorea Harvey.

Sitka, Alaska, *Ruprecht* (1851, p. 399 under *Ch. tortuosa* var. *crassior*).

Harvey (1857, p. 87) refers Ruprecht's variety *crassior* of

Ch. tortuosa to his own *Ch. litorea* and this is as far as any information concerning the plant from Sitka is known to us.

Chætomorpha tortuosa (Dillwyn) Kuetzing.

"Parasitic" on *Ch. melagonium*. Unalaska, Alaska, *Ruprecht* (1851, p. 397, under *Conferva confervicola*).

Harvey (1857, p. 88) says that he has received a specimen of the *Conferva confervicola* Ruprecht from Ruprecht himself and cannot distinguish it from the present species. It seems, also, that the *Conferva Linum* of Postels and Ruprecht (1840, p. 22) may belong with it, since they mention that the specimens referred to that species and collected at Sitka, are only half as thick as European specimens of *Ch. Linum* (Mueller) Kuetzing Another possibility seems likely to us, and that is that the specimens quoted here may also be identical with what Mr. Collins and Kjellman have referred, of North Pacific forms, to *Ch. cannabina*, mentioned above.

Chætomorpha melagonium (Weber et Mohr) Kuetzing.

In tufts over two feet long. Unalaska and Kadiak Islands, Alaska, *Ruprecht* (1851, p. 397, under *Conferva Melagonium*).

Chætomorpha melagonium f. typica Kjellman.

In the sublitoral zone. St. Lawrence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 55); St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5785a! (Setchell, 1899, p. 590).

Chætomorpha melagonium f. rupincola (Areschoug) Kjellman.

Yakutat Bay, Alaska, *Saunders* (1901, p. 413).

Rhizoclonium riparium f. implexum (Dillwyn) Rosenvinge.

On roots, mud, stones, etc., litoral zone. St. Michael, Alaska, *W.A.S.*, Nos. 5241!, 5244!; east shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4006!; Yakutat Bay, Alaska, *Saunders* (1901, p. 414); Departure Bay, B. C., *W. A. S. and A. A. L.*, No. 5210!, and in Collins, Holden and Setchell, P. B.-A., No. 976!; Peddler Inlet, Strait of Juan De Fuca, Vancouver Island, B. C., *Tilden*, No. 379! (under *Rh. riparium*); Whidbey Island, Wash., *N.L.G.*, Nos. 296!, 414!; San Juan Island, Wash., *N.L.G.*, No. 205!

Rhizoclonium tortuosum Kuetzing.

On other algæ in the middle litoral zone. Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5095!; Whidbey Island, Wash., *N.L.G.*, Nos. 423!, 670!

Cladophora crispata f. vitrea (Kuetzing) Rabenhorst.

Fresh water. University Boat House, Lake Washington, Seattle, Wash., *Tilden*, No. 277!

This form is quoted as Miss Tilden has given it. There are no authentic specimens accessible, either to Mr. Collins or to ourselves, and the specimens must be left for further study.

Cladophora glomerata (L.) Kuetzing.

Lake Scheveltza, Vancouver Island, B. C., *Harvey* (1862, p. 177).

We have no knowledge of the occurrence of this species in our territory except that conveyed by the reference quoted.

Cladophora callicoma Kuetzing.

Attached to floating logs. Lake Washington, Seattle, Wash., *N.L.G.*, Nos. 507!, 508!, and in Collins, Holden and Setchell, P. B.-A., No. 919!, *W.A.S.* and *A.A.L.*, No. 5212!

A fresh water species, determined by Mr. Collins. Dr. Bornet has written that the specimen distributed under Collins, Holden and Setchell, P. B.-A., No. 919, seems to him to be *C. glomerata* f. *macrogonya* (Lyngbye) Rabenhorst.

Cladophora cartilaginea (Ruprecht) Harvey.

Unalaska, Alaska, *Ruprecht* (1851, p. 404 under *Conferva cartilaginea*).

Cladophora saxatilis (Ruprecht) DeToni.

On rocks in the lower part of the litoral zone. Near Friday Harbor, San Juan Island, Wash., *N.L.G.*, Nos. 207!, 220!, *Tilden*, No. 279! (under *C. arcta*); Channel Rocks, west of Seattle, Wash., *N.L.G.*, Nos. 355!, 309!, and in Collins, Holden and Setchell, P. B.-A., No. 921!; Ludlow Bay, Wash., *N.L.G.*, Nos. 440!, 513!

The determination of the above are all by Mr. Collins, who adds that Tilden, No. 375, is not *C. saxatilis*, probably not even

of the same section of the genus, but the specimen distributed is not further determinable.

Cladophora flexuosa (Griffiths) Harvey.

Annette Island, Alaska, *Saunders* (1901, p. 414).

Cladophora Mertensii (Ruprecht) DeToni.

St. Paul Island, Alaska, *Setchell* (1889, p. 590?); Sitka, Alaska, *Ruprecht* (1851, p. 403, under *Conferva Mertensii*).

Cladophora viminea (Ruprecht) DeToni.

Unalaska and Sitka, Alaska, *Ruprecht* (1851, p. 403, under *Conferva viminea*).

Cladophora glaucescens (Griffiths.) Harvey.

Nanaimo, Vancouver Island, B. C., *Harvey* (1862, p. 196).

Cladophora lætevirens (Dillwyn) Kuetzing.

"Fuca Strait," Vancouver Island, B. C., *Harvey* (1862, p. 177).

Cladophora Chamissonis (Ruprecht) DeToni.

"Parasitic" on the walls of Halosaccion or Rhodymenia, Unalaska, Alaska, *Ruprecht* (1851, p. 403); floating, San Juan Island, Wash., *N. L. G.*, No. 232!, and in Collins, Holden and Setchell, P. B.-A., No. 920!

Determined by Mr. Collins, who notes that the specimens of Gardner are so like the Ruprecht specimen in Herb. Farlow, that it should be noted separately from *C. saxatilis* which it resembles very closely.

Cladophora arcta (Dillwyn) Kuetzing.

On rocks and Fucus, middle and lower litoral zones. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3288!; Sand Point, Popof Island, Alaska, *Saunders* (1901, p. 414); Cormorant Rocks, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5133!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5140!; Orca, Alaska, *W.A.S. and A.A.L.*, No. 5181!; Ocean Cape, Yakutat Bay, Alaska, *Saunders* (1901, p. 414); Glacier Bay, Alaska, *Saunders* (1901, p. 414); Esquimalt, B. C. and Orcas Island, Wash., *Harvey* (1862, p. 176).

Mr. Collins has made all the determinations quoted except, of course, those of Harvey. Harvey's specimens may belong rather under *C. scopæformis* or *C. saxatilis*, since his *C. arcta* is of the older and broader conception. Mr. Collins also notes that Miss Tilden's *C. arcta* (No. 373) can belong to this species only in its very broadest sense, but that the specimens distributed are not good enough to be determined with accuracy.

Cladophora arcta f. **conglutinata** F. S. Collins f. nov.

Filaments adhering in drying into pointed tufts; descending rhizoids plentiful. In addition to the regular, erect, blunt branches, there are at the base of the older plants some patent lateral branches with acute terminal cells.

On stones and rocks, litoral zone. St. Michael, Alaska, *W.A.S.*, No. 5255x!; near Dutch Harbor, Amaknak Island, Bay of Unalaska, Alaska, *R. C. McGregor*, No. 5693!, *W. A. S. and A.A.L.*, No. 4080!; Karluk, Kadiak Island, Alaska, *W.A.S.*, Nos. 5068!, 5069!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5086!; Esquimalt, B. C., *N.L.G.*, No. 329!; Channel Rocks, west of Seattle, Wash., *N.L.G.*, No. 356!; near Deer Harbor, San Juan Island, Wash., *N.L.G.*, No. 202! (battered form).

The typical *C. arcta* shows a flabellate or nearly circular outline in the mounted specimen, the individual filaments being quite free. The present form has quite a different habit, the filaments uniting in tufts like a magnified Symploca. The acute lateral branches show a tendency toward *C. spinescens*, but are not regularly curved or circinate as in the latter.

Cladophora arcta f. **pulvinata** (Foslie) F. S. Collins comb. nov.

On mussels and algæ, tide pools, upper litoral zone. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4002!, and in Collins, Holden and Setchell, P. B.-A., No. 918! Determined by F. S. Collins.

Cladophora lanosa var. **uncialis** (Mueller) Thuret.

On rocks, upper litoral zone. San Juan Island, Wash., *Tilden*, No. 372!

Mr. Collins, after a study of the specimens quoted, says that the plants are certainly not *C. lanosa* var. *uncialis*, being very much coarser, but are in too poor condition for determination.

Cladophora cohærens (Ruprecht) DeToni.

Ruprecht gives this species as occurring in the North Pacific Ocean, and probably from the Ochotsk Sea. Mr. Collins has examined a Ruprecht specimen and notes that he cannot find any differences between this species and *C. arcta* of the North Atlantic.

Cladophora Hystrix (Stroemfelt) DeToni.

On Fucus, lower litoral zone. Gonzales Point, Victoria, B. C., *Tilden*, No. 374! (under *C. arcta* form b.)

Mr. Collins notes that this specimen seems to be Stroemfelt's *Spongomorpha Hystrix*.

Cladophora composita Harvey et Hooker.

Forming dense mats on rocks, litoral zone. Port Renfrew, B. C., *Tilden*, No. 376! (under *C. cartilaginea*); East Sound, Orcas Island, Wash., *N.L.G.*, No. 521!

The determinations are by Mr. Collins, who says of Miss Tilden's specimen that it belongs here and that there are no two species of Cladophora more utterly unlike than *C. composita* and *C. cartilaginea*.

Cladophora Columbiana F. S. Collins sp. nov.

Forming intricate masses about 3 cm. high, filaments somewhat prostrate at the base, then erect, sparingly dichotomous below, densely di- or trichotomously branched towards the fastigiate tips, having occasional solitary or secund lateral branches; filaments 150–250 μ diam., cells somewhat piriform, 3–6 μ diam., long, usually largest at the point of forking, smallest at the base of the cell above; branches and ramuli as large as the main filaments, terminal cell blunt, usually somewhat clavate. Color deep, rich green; cell wall thick, pellucid.

Port Renfrew, B. C., *Butler and Polley!*

Related to *C. patentiramea* (Montagne) Kuetzing., but with larger diameter and shorter cells, and more densely and fastigi-

ately branched. Also resembling some forms of *C. utriculosa* Kuetzing, but a smaller plant, more matted in growth, and with cells cylindrical to piriform, rather than ovoid with constricted nodes. *C. densa* Harvey is looser in growth, with longer cells and subacute tips.

Cladophora coalita (Ruprecht) DeToni.

Attached to rocks in the lower litoral zone. West shore of Whidbey Island, Wash., *N.L.G.*, No. 95!

Mr. Collins writes that this species and the next have been confused under the name of the latter. They are, however, certainly distinct forms, and he is inclined to think, distinct species. No. 819, Collins, Holden and Setchell, P. B.-A., collected at San Francisco, California, by R. E. Gibbs, belongs under the present species and not under the next.

Cladophora scopæformis (Ruprecht) Harvey.

Attached to rocks exposed to considerable wave action. Kukak Bay, Yakutat Bay, and Sitka, Alaska, *Saunders* (1901, p. 414); Port Renfrew, B. C., *Butler and Polley*, No. 16; Esquimalt, B. C., *N.L.G.*, Nos. 323!, 512!, 525!; west shore of Whidbey Island, Wash., *N.L.G.*, No. 18!, 122!, 203!, 516!, 517!, and in Collins, Holden and Setchell, P. B.-A., No. 922!.

This plant which is the most common species in the region of Puget Sound, is closely related to the preceding and the two differ from the other species in our list, with the exception of *C. spinescens*, by having the older parts bound together in rope-like masses by curving and hooked branchlets. *C. coalita* has stouter filaments and shorter cells than *C. scopæformis*. Mr. Collins has supplied the determinations and the notes.

Cladophora spinescens Kuetzing.

In spongy masses, on the tips of algæ and sponges, uppermost litoral zone in exposed places. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3258!

Determined by F. S. Collins.

Cladophora Alaskana F. S. Collins sp. nov.

Tufts 15–25 cm. high, erect, main filaments about 300 μ diam., articulations one-half to one and one-half diam., branches similar, erect, scattered or in secund series of two or more, not tapering, terminal cells blunt, wall thick, striate: branches near base of the tuft slenderer, 200–250 μ diam., with thinner walls, not striate, with numerous short, patent or recurved ramuli, scattered or in secund series. Color dark green, becoming whitish on exposure.

On rocks, forming a distinct belt at the lower tide limit. St. Paul Island, Alaska, Herb. *D. C. Eaton*, No. 4!; west shore of Amaknak Island, Bay of Unalaska, Alaska. *W.A.S. and A.A.L.*, Nos. 3259!, 4000!, 5045a!, and in Collins, Holden and Setchell, P. B.-A., No. 917!

The slender divaricate lower branches resemble somewhat the interlacing branches in the subgenus Spongomorpha, but they are not clearly differentiated, the two forms of branches in this species passing into each other. The tufts are never densely matted as in Spongomorpha.

Cladophora Hutchinsiæ var. **distans** Kuetzing.

Port Renfrew, B. C., *Butler and Polley*, No. 127!

Mr. Collins says of this, that it may be the plant called *C. læte-virens* by Harvey in his "List" (1862), but that it is not the plant properly to be placed under that name.

The species of Cladophora are always difficult to determine, and this is especially true of the species of the Pacific Coast of North America. All of our material has been sent to Mr. Collins and besides his special reports on each specimen, he has written the following account of the result of his study of the Ruprecht descriptions, supplemented by a considerable number of Ruprecht specimens in Herb. Farlow. His report reads as follows:

"Ruprecht gives nine species, all of the Aerosiphonia-group as follows:

1. C. cohærens.	4. C. viminea.	7. C. cartilaginea.
2. C. Chamissonis.	5. C. saxatilis.	8. C. scopæformis.
3. C. Mertensii.	6. C. duriuscula.	9. C. coalita.

C. cohærens according to Ruprecht, represents *C. arcta* of the Atlantic, and is possibly only a form of the latter. I cannot see any differences, and have simply called the specimens *C. arcta.* The next four species seem to me to be indistinguishable, either by the authentic specimens or by the descriptions. I have used the name *C. saxatilis*, both as the first name used, and the one having the fullest description. *C. duriuscúla* is not represented in the herbarium and I do not think that it can be made out from the description. *C. cartilaginea* is a well marked species, but is not among the specimens you have sent me; it is in my collection from Monterey. The last two species have been confused under the name *C. scopæformis*, but are certainly distinct forms, and I am inclined to think, distinct species. Both are coarse plants, all the older parts matted in rope-like masses by curving and hooked branches. *C. coalita* has stouter filaments and shorter cells. The hooked branches are characteristic of these two species, and seldom if ever found in the other species of this list. These two species have very blunt tipped branches, while the Ruprecht specimens of *C. Chamissonis*, *C. viminea*, and *C. saxatilis*, all have the tips acute or acuminate. The mattedness of the lower part of the last three species is not due to hooked branchlets, but to descending rhizoid-like branchlets as in *C. arcta.* *C. polaris* Harvey, New Algæ of Japan, Proc. Amer. Acad., Vol. 4; p. 334, 1859, is the young state of *C. scopæformis.*"

Family GOMONTIACEÆ.

Gomontia polyrhiza (Lagerheim) B. & F.

In dead shells. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3248!; Popof Island, Alaska, *Saunders* (1901, p. 415); Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5110!

Family BOTRYDIACEÆ.

Botrydium granulatum (L.) Greville.

This species has been seen and collected on Camano and Whidbey Islands by one of us (*N.L.G.*) but no specimens were preserved. There is, however, no doubt as to its occurrence.

FAMILY BRYOPSIDACEÆ.

Bryopsis hypnoides Lamouroux.

Growing on old wood of floats and piles. Victoria, B. C., *N.L.G.*, No. 510!; British Camp, San Juan Island, Wash., *N.L.G.*, No. 206!

Determined by F. S. Collins.

Bryopsis corticulans Setchell.

On rocks at low water mark. Sackman's Point, near Tracyton, Kitsap County, Wash., *Tilden*, No. 371! (under *B. plumosa*).

This differs from *B. plumosa*, in being coarser and less regularly distichous, but the corticating filaments are very nearly wanting. It seems best to refer it to *B. corticulans*, which may, however, only be an extreme form of *B. plumosa*. Mr. Collins notes that the specimen in the copy of the American Algæ in Herb. Farlow, seems to be good *B. corticulans*.

FAMILY DERBESIACEÆ.

Derbesia vaucheriæformis (Harvey) J. Agardh.

On a sponge. Yakutat Bay, Alaska, *Saunders* (1901, p. 415).

Derbesia marina (Lyngbye) Solier.

In quiet water. Sitka, Alaska, *Saunders* (1901, p. 415).

FAMILY VAUCHERIACEÆ.

Vaucheria sessilis (Vaucher) DC.

On a dripping cliff, Juneau, Alaska, *Saunders* (1901, p. 415); in a small stream of running water, Seattle, Wash., *N.L.G.*, No. 384!

Vaucheria geminata var. **racemosa** Walz.

Seattle, Wash., *N.L.G.*, No. 668!

Vaucheria hamata (Vaucher) Lyngbye.

On moist ground. Near Green Lake, Seattle, Wash., *N.L.G.*, No. 368!

Vaucheria terrestris Lyngbye.

In a ditch. Near the University of Washington, Seattle, Wash., *N.L.G.*, No. 392!

Family CODIACEÆ.

Codium adhærens (Cabr.) Agardh.

Dredged in a depth of 15 meters, Kadiak Island, Alaska, *Saunders* (1901, p. 416); very sparingly on rocks in the upper sublitoral zone, west shore of Whidbey Island, Wash., *N.L.G.*, No. 265!

Codium Ritteri Setchell and Gardner sp. nov. Plate 17.

Frond globose to piriform, 3 cm. high, attached by a distinct stipe-like base, solid, the center composed of a felt-like mass of fine fibres. Outer filaments or utricles, free, blunt, 150–400 μ in diameter, the older ones usually swollen in the middle, and having the membrane at the tip somewhat thickened at the central point projecting inwards. Zoosporangia unknown.

The type of the species proposed here is a single specmen collected at Berg Bay, in two or three fathoms of water, by Professor W. E. Ritter, of the University of California, while on the Harriman Expedition to Alaska. A second specimen, agreeing apparently in habit and structure, but not in the description of its habit, is No. 370 of Miss Tilden's American Algæ, collected by her at Port Renfrew, Vancouver Island, B. C., and distributed under the name of *Codium adhærens.*

Codium Ritteri approaches both *C. Bursa* (Turner) Agardh and *C. mamillosum* Harvey, but is distinct from both. From the former it differs in being solid and in having a more distinct stipital portion, while from the latter it differs in having a more distinct stipital portion and the smallness of the utricles as well as the shape of the utricles. The utricles, in a specimen of Mme. Weber van Bosse, kindly loaned by F. S. Collins, are balloon-shaped, and measure from 1 to 2 mm. in diameter. From *C. adhærens*, *C. Ritteri* is amply distinct, since it has not the firm jelly uniting the utricles, which is so characteristic of that species. It is to be noted that *C. mamillosum* is credited to

Japan by DeToni (1895, p. 63), but No. 49 of Okamura's Algæ Japonicæ Exsiccatæ, seems to us to be our *C. Ritteri*, though labelled *C. mamillosum*.

Codium mucronatum f. Californicum J. Agardh.

On rocks and in tide pools, lower litoral and upper sublitoral zones. Sitka, Alaska, *J. G. Agardh* (1886, p. 44), *Saunders* (1901, p. 416); San Juan Harbor, Strait of Juan de Fuca, Vancouver Island, B. C., *Tilden*, No. 281!, under *C. tomentosum*; Whidbey Island, Port Townsend, and Ludlow Bay, Wash., *N.L.G.*!

In all probability are to be included here, the specimens referred to *C. tomentosum* as follows:—Norfolk Sound (Sitka Sound) and Nootka Sound, *Postels and Ruprecht* (1840, p. 20); Nootka Sound, *Turner* (1811, p. 135, under *Fucus tomentosus*); Esquimalt, B. C., *Harvey* (1862, p. 176).

Codium mucronatum f. Novæ Zelandiæ J. Agardh.

Port Renfrew, B. C., *Butler and Polley*, No. 5!

A careful study of *C. mucronatum* will probably show a very decided variation in the size and occurrence of the mucronate tip of the utricle. In the plants included under the preceding form, all studied by us have the typical tip of the f. *Californicum*. In the plant quoted under the present form, the mucronate tip to the utricle is to be found only in the very young portions of the frond. Below, in the older portions, the utricles are more or less swollen at the tip, as in *C. Muelleri* Kuetzing, and while some of them show a very slight apiculus, the majority of them do not. The plant certainly differs from the more usual form on the Pacific Coast of North America.

FAMILY VALONIACEÆ.

Valonia ovalis (Lyngbye) Agardh.

On rocks exposed to the waves at extreme low water mark. Port Renfrew, B. C., *Butler and Polley*, No. 26!

This northern representative of a tropical genus was first found on the Pacific Coast of North America by Saunders (1899, p. 2) near Pacific Grove, California. It has also been collected

at Point Cypress, near Pacific Grove, by Professor Harold Heath, of Stanford University. In both these localities, as well as in the locality quoted above, it was found growing on a substratum of Lithothamnia.

FAMILY CHARACEÆ.

Nitella acuminata subglomerata A. Braun.

In a fresh water pond, near Prince William Sound, Alaska, *Saunders* (1901, p. 416).

Nitella opaca Agardh?

In a fresh water pond near Kadiak, Alaska, *Saunders* (1901, p. 416).

Chara contraria A. Braun.

In ponds and streams near Glacier Bay, Alaska, *Saunders* (1901, p. 416).

Chara fragilis Desv.

In a fresh water pond, Shumagin Islands, Alaska, *Saunders* (1901, p. 416).

PHÆOPHYCEÆ.

In this group we have included all algæ with an additional brown coloring matter, even taking in Hydrurus, which does not seem to belong anywhere. In the arrangement of genera and in the adoption of generic names, we have followed Kjellman (1891–1896) in Engler and Prantl, with some exceptions, particularly in the Laminariaceæ. As to species, while DeToni (1895) has been of considerable assistance, it has been necessary to rely chiefly upon the special papers for more light to determine doubtful points and to make necessary revisions. In this group much help is to be obtained from the papers of Mertens (1829), Postels and Ruprecht (1840), Ruprecht (1851), and Saunders (1901). We have the pleasure of thanking Mr. Collins for some determinations, and for looking over our manuscript and making valuable suggestions. Professor F. R. Kjellman, of Upsala, Sweden, very kindly examined a series of specimens of the very puzzling

genus Alaria and contributed determinaions and notes without which our account would have been extremely meager.

In this group we find a mixture of forms of North Atlantic affinities mixed with types of Antarctic affinities. The genera Macrocystis, Nereocystis, Lessonia, Postelsia, Dictyoneuron, and Egregia are most closely related to Laminariaceæ of the Antarctic Ocean, some species of Chorda, Laminaria, Agarum, Alaria, and Fucus are identical with those of the North Atlantic, while others of the same genera are very closely related to the North Atlantic forms. We have selected the species and genera just mentioned, because they are large and typical. A detailed list would only show the same thing and make the proportions plain. The proportions, however, if taken from such a list as could be compiled at present, would probably not hold as soon as we have a little more complete knowledge than we have at present. In the group of the Phæophyceæ, too, we see the mingling of the algal flora of the North Temperate Region and the Lower Boreal Region very plainly. The Antarctic types belong properly with the North Temperate, although some of them, notably Nereocystis, extend through the Lower Boreal, but are wanting, as we have reason for believing, in the Upper Boreal. The North Atlantic types, on the other hand, are characteristic of the Lower Boreal and are represented in the North Temperate by fewer species or mostly by species related to, but not identical with, the species of the North Atlantic. A comparison with the Phæophyceæ of the northeastern coast of Asia, is not possible, at least with the expectation of satisfactory results. The algal flora of Ochotsk Sea, is very similar to that of Bering Sea, and this Upper Boreal flora reaches to the northern extremity of Japan, but beyond that our present knowledge of the flora of Japan in the Lower Boreal Region is not sufficient to allow any very definite statements to be made. A comparison with the coasts of the United States below Cape Flattery might be made, especially with those included in the North Temperate Region, but it is sufficient to say that many of the species of that flora have already been found in the lower limits of the Lower Boreal Region and many more will probably be added when our knowledge approximates completeness.

Family HYDRURACEÆ.

Hydrurus fœtidus (Vill.) Kirchner.

On rocks and stones in cold rapid streams. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5042!; Kukak Bay, Alaska, *Saunders* (1901, p. 400); Juneau, Alaska, *W.A.S. and A. A. L.*, No. 5189!; Vancouver Island, B. C., *Harvey*, (1862, p. 177).

This species occurs in several of its forms in each Alaskan locality.

Family ECTOCARPACEÆ.

Pylaiella litoralis (L.) Kjellman.

Attached to various algæ or woodwork. St. Lawrence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 51); Norton Sound, Alaska, *R. C. McGregor*, No. 5678!; "Fuca Strait" and Esquimalt, B. C., *Harvey* (1862, p. 167).

This very variable species has been divided into a number of varieties and forms by Kuckuck, Kjellman, and other writers. The specimens and references given above are not referable easily under their proper forms and are mentioned here. Below are given such as are more or less readily referred under published varietal and form names. It seems that the following two species are probably to be placed under *P. litoralis*, also: P. *atroviolacea* Ruprecht (1851, p. 385) from Sitka and perhaps also from Unalaska, collected by Mertens, and *Ectocarpus Aleuticus* Kuetzing (1860, p. 1, pl. 2, 1) also collected at Unalaska by Mertens.

Pylaiella litoralis var. **opposita** f. **typica** Kjellman.

On Fucus, St. Michael, Alaska, *W.A.S.*, Nos. 5238y!, 5247x!

Pylaiella litoralis var. **opposita** f. **rupincola** Kjellman.

On piles or floating logs. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4025!; LaConner, Skagit County, Wash., *N.L.G.*, No. 339!

Pylaiella litoralis var. **opposita** f. **acuta** Saunders.

On Fucus, Kukak Bay, but generally abundant from Wrangell, Alaska, to the Aleutian Islands, *Saunders* (1901, p. 418).

It has seemed best to place Saunders's form under the variety *opposita*, as Saunders leaves it indefinite in this case as he does in the whole treatment of this species as to whether he recognizes any special grouping of the forms or not. The general grouping of Kuckuck and Kjellman seems to us the most convenient and natural arrangement possible and to be followed as nearly as can be done, with the understanding that a study of the life-history may indicate that many of the forms are rather states of development. Saunders's description of the form does not seem to indicate much difference between this and f. *rupincola* Kjellman.

Pylaiella litoralis var. **opposita** f. **rectangulans** Kuckuck.

Floating in pools in a salt marsh. Orcas Island, Wash., *N.L.G.*, No. 627!

Pylaiella litoralis var. **firma** (Agardh) Kjellman.

On Fucus. Dutch Harbor, Amaknak Island, Bay of Unalaska, Alaska, *R. C. McGregor*, No. 5696!; Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3271!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5103!; East Sound, Orcas Island, Wash., *N.L.G.*, No. 476!

These forms are all lumped under the variety without attempt to separate them. One or two of them probably belong to f. *typica* Kjellman.

Pylaiella litoralis var. **firma** f. **macrocarpa** (Foslie) Kjellman.

On Fucus. Victoria, B. C., *Saunders* (1901, p. 419).

Pylaiella litoralis var. **varia** (Kjellman) Kuckuck.

Common on rocks and on Fucus. Shumagin Islands, Yakutat, and Juneau, Alaska, and at Victoria, B. C., *Saunders* (1901, p. 419); Port Renfrew, B. C., *Tilden*, No. 360!

Pylaiella litoralis var. **varia** f. **densa** Saunders.

On Fucus or other algæ, occasionally upon rocks. Shumagin Islands, Prince William Sound, and Sitka, Alaska, and Victoria, B. C., *Saunders* (1901, p. 419); Uyak Bay, Kadiak Island, Alaska, *W.A.S.* and *A.A.L.*, No. 5135a!; Saunders's f. *densa* seems to come under the var. *varia* (Kjellman) Kuckuck.

Ectocarpus terminalis Kuetzing.

On stipes of *Alaria fistulosa* P. & R. Iliuliuk, Unalaska, Alaska, *W.A.S.* and *A.A.L.*, No. 5044a!

Ectocarpus siliculosus f. **typicus** Kjellman, emend. Kuckuck.

On wood. Juneau, Alaska, *W.A.S.* and *A.A.L.*, No. 5197!

The specimens referred to the species are very typical and with good plurilocular sporangia. Harvey (1862, p. 167) has noted this species from Esquimalt, B. C., growing on Nereocystis.

Ectocarpus confervoides (Roth) LeJolis.

On rocks, etc. Yakutat, Alaska, *Saunders* (1901, p. 418); Port Renfrew, B. C., *Butler and Polley*, No. 24; near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 261!

These may be forms more or less typical, but the information is not exact in this respect.

Ectocarpus confervoides f. **typicus** Kjellman.

On Alaria. Juneau, Alaska, *W.A.S.* and *A.A.L.*, No. 5196!

Ectocarpus confervoides f. **pygmæus** (Areschoug) Kjellman.

On various algæ. Shumagin Islands and Yakutat Bay, Alaska, *Saunders* (1901, p. 418).

Ectocarpus confervoides f. acuminatus Collins and Setchell f. nov.

Habit and plurilocular sporangia of *E. penicillatus* Agardh, but the branches and branchlets are acuminate instead of ending in a hair.

On algæ, particularly Desmarestia. Whidbey Island, Wash., *N.L.G.*, Nos. 235!, 448!; Victoria, B. C., *N.L.G.*, No. 317!

The type is No. 235 and seems to be the same as the *E. penicillatus* of Saunders's Phycological Memoirs (1898, p. 155, pl. 21, f. 3, 4). It differs from *E. penicillatus* as figured and described by Kuckuck (1891, p. 22, f. 5) in the lack of hairs and in the lack of the pseudodichotomous branching. It is to be distinguished from other forms of *E. confervoides* by the acuminate terminal cells of the branches and branchlets.

Ectocarpus confervoides f. variabilis Saunders.

On larger algæ and on a chiton. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 166!, 426!, 454!, 465!

The plants placed under this form are referred here with some doubt and need more study, as does the form itself, to determine its autonomy. Some of the plants make it seem likely that *E. chitinicolus* Saunders, and perhaps even *E. mucronatus* Saunders, are likely to be found to belong to the form cycle of *E. confervoides*.

Ectocarpus confervoides f. corticulatus Saunders.

On *Desmarestia aculeata*. Popof Island, Alaska, *Saunders* (1901, p. 418).

Ectocarpus granulosus (Engl. Bot.) Agardh.

Cast ashore. Near Tracyton, Kitsap County, Wash., *Tilden*, No. 359a!

A slender form of this species. Mr. F. S. Collins has examined the specimen in Herb. Farlow and agrees in the determination. No. 359b is referred by him to *E. mucronatus* Saunders.

Ectocarpus mucronatus Saunders.

In tide pool. Port Renfrew, B. C., *Tilden*, No. 359b!, under *E. granulosus*.

Mr. F. S. Collins has determined this specimen as belonging to this species. It seems to us that the species itself may probably be referred to some form of *E. confervoides*, on further study.

Ectocarpus tomentosus (Hudson) Lyngbye.

On Fucus. Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5104!; Sitka, Alaska, and Victoria, B. C., *Saunders* (1901, p. 417).

Ectocarpus oviger Harvey.

On stipes of Nereocystis. Esquimalt, B. C., *Harvey* (1862, p. 167).

A species unknown to us, said to be near to *E. granulosus* (Engl. Bot.) Agardh.

Ectocarpus cylindricus Saunders.

On the shell of a chiton. West coast of Whidbey Island, Wash., *N.L.G.*, No. 466!

Determined by DeAlton Saunders.

Streblonema minutissimum Saunders.

"In the branches of Liebmannia sp." Sitka, Alaska, *Saunders* (1901, p. 416).

Streblonema Pacificum Saunders.

Forming dark brown, circular patches on the sporophylls of Alaria. Yakutat Bay, Alaska, *Saunders* (1901, p. 417).

Streblonema irregulare Saunders.

Forming small brown patches on the bulbs of Nereocystis. Sitka, Alaska, *Saunders* (1901, p. 417).

Phycocœlis Baltica (Reinke) DeToni.

On various algæ. Sitka, Alaska, *Saunders* (1901, p. 416); west coast of Whidbey Island, Wash., *N.L.G.*, No. 454!

Placed by Foslie under *Myrionema*.

FAMILY SPHACELARIACEÆ.

Sphacelaria cirrhosa (Roth) Agardh.

Forming small light olive-green tufts on Fucus. Annette Island, Alaska, *Saunders* (1901, p. 419).

Sphacelaria racemosa var. **arctica** (Kjellman) Reinke.

St. Lawerence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 51); Prince William Sound, Yakutat, and Wrangell, Alaska, *Saunders* (1901, p. 419); west coast of Whidbey Island, Wash., *N.L.G.*, No. 245!

Chætopteris plumosa (Lyngbye) Kuetzing.

Sublitoral zone. St. Lawrence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 51); Alaska, *Harvey* (1872, p. 463).

Cladostephus verticillatus (Lightfoot) Agardh.

North Pacific Ocean, *Postels* and *Ruprecht* (1840, p. 21).

FAMILY ENCŒLIACEÆ.

Desmotrichum undulatum (J. Agardh) Reinke.

On *Zostera marina*, in a quiet cove. Near Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 419, under *Homœostroma undulatum*.)

This seems more like a narrow Punctaria, since according to both the description and figure of Saunders the plurilocular sporangia hardly project beyond the surface of the frond.

Punctaria latifolia Greville.

In quiet waters, floating or attached to other algæ. Popof Island, Sitka, and Annette Island, Alaska, *Saunders* (1901, p. 420, under *Homœostroma latifolium*); Penn's Cove, near Coupeville, Whidbey Island, Wash., *N.L.G.*, No. 190!

Homœostroma lobatum Saunders, from Sitka and Prince William Sound, Alaska, seems from description and figure to be a form of this species or the next with much lobed margins. It reminds us of *Phycolapathum crispatum* Kuetzing (1856, p. 16, pl. 49, f. I).

No. 190, N.L.G., may be a distinct form, since it reaches a diameter of over a meter and seems to increase, in its floating state, indefinitely, in a way similar to that of *Ulva Lactuca* var. *latissima*.

Punctaria plantaginea (Roth) Greville.

On exposed rocks. Port Clarence, Alaska, *Kjellman* (1889, p. 50); Yakutat Bay, Alaska, *Saunders* (1901, p. 420).

Coilodesme bulligera Stroemfelt.

On rocks and stones, in quiet coves, in the lower litoral zone. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3285!, 4081!, and in Collins, Holden and Setchell, P. B.-A., No. 923b!; Shumagin Islands, Kukak Bay, Prince William Sound, Yakutat Bay, and Wrangell, Alaska, *Saunders* (1901, p. 422), and in Collins, Holden and Setchell, P. B.-A., No. 923a!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 201!

It is very interesting to note the common occurrence of this species in the Northern Pacific Ocean, at least so far as the North American Coast is concerned, since before the collections

noted (made in the year 1899) it was unknown, except from the Arctic coasts of Norway, Iceland and Greenland.

Coilodesme Californica (Ruprecht) Kjellman.

Epiphytic on *Cystophyllum geminatum.* Yakutat Bay, Wrangell, and Annette Island, Alaska, *Saunders* (1901, p. 422); Port Renfrew, B. C., *Butler and Polley*; Esquimalt, B. C., *W.A.S.*, No. 1874!; Victoria, B. C., *Saunders* (1901, p. 422); west coast of Whidbey Island, Wash., *N.L.G.*, No. 679!; Friday Harbor, San Juan Island, Wash., *Tilden*, No. 354!

Coilodesme Cystoseirae (Ruprecht) Setchell and Gardner comb. nov.

Asperococcus Cystoseiræ Ruprecht, Tange Och., p. 370, 1851.

Coilodesme linearis Saunders, Alaskan Algæ, p. 421, pl. 48, 1901, and in Collins, Holden and Setchell, P. B.-A., No. 824, 1901.

On *Cystophyllum geminatum.* Popof Island and Kukak Bay, Alaska, *Saunders* (1901, p. 421) and in Collins, Holden and Setchell, P. B.-A., No. 824!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5698!

Ruprecht's description of this species is very explicit, not only of the habit and habitat, but also of the microscopic structure, so that there can be no doubt as to the identity of the two sets of plants. From Ruprecht's account it seems to be abundant in the Ochotsk Sea. While the extreme forms of these two species on Cystophyllum are amply distinct, there are narrower forms of *C. Californica*, approaching to some extent the more robust *C. Cystoseiræ*, so that it does not seem impossible that the latter may be only a pronounced geographical variety of the former.

Myelophycus intestinalis Saunders.

Attached to rocks in the more quiet waters in the lower litoral and upper sublitoral zones. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos 3287!, 4019!; Popof Island, Alaska, *Saunders* (1901, p. 420) and in Collins, Holden and Setchell, P. B.-A., No. 872!; Yakutat Bay, Glacier Bay, and Sitka, Alaska, *Saunders* (1901, p. 420); Fairhaven and Whidbey Island, Wash., *N.L.G.*, Nos. 188!, 215!

While this species seems to be a *Myelophycus* in Kjellman's sense, yet it seems to us that the whole question of the relation of this genus to *Analipus* and to *Chordaria* is very unsatisfactory as yet. Younger plants of this species are needed for study in this connection, so that the region or regions of growth may be more definitely established. Further discussion will be found under Chordaria and Analipus.

Colpomenia sinuosa (Roth) Derbes et Solier.

Growing on other algæ, in the lower litoral zone. Prince William Sound and Yakutat Bay, Alaska, *Saunders* (1901, p. 421); Port Renfrew, B. C., *Tilden*, No. 522!, *Butler and Polley*, No. 111!

The specimens included here are evidently the thinner forms, or may be even states due to age, which Saunders has considered the typical form. While we cannot refer to the type to settle the question, we believe that the thinner forms, whether single and more regular in shape (*C. sinuosa* Saunders, 1896, p. 164, pl. 32, f. 7, 8) or the aggregate expanded forms (*C. sinuosa expansa* Saunders, 1898, p. 164, pl. 32, f. 4–6) are merely younger plants which become thicker and darker brown as they become older

Colpomenia sinuosa f. **tuberculata** (Saunders) Setchell and Gardner comb. nov.

C. tuberculata Saunders, Phycological Memoirs, p. 164, pl. 32, f. 1–3, 1898.

On other algæ in the lower litoral zone. Northeast shore of Captains Bay, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4090!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 106!

This plant, as it seems to us from a study not only of material from the northwest coast, but also from a study of Californian specimens, is only a somewhat thicker, more or less distorted form of *C. sinuosa*, and we feel that all the autonomy necessary is indicated by a different form-name.

Colpomenia sinuosa f. **deformans** Setchell and Gardner nom. nov. PLATE 18.

Scytosiphon bullosus Saunders, Phycological Memoirs, p. 163, pl. 31, f. 1–7, 1898.

On rocks in the lower litoral zone. Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 421) and in Tilden, American Algæ, No. 351b!; Sitka, Alaska, *Saunders* (1901, p. 421); all under *Scytosiphon bullosus*.

A careful comparison of the specimens of this species of Saunders as to the specimens distributed and as to the plants in the type locality at Pacific Grove, California, has convinced us that every stage can be found, sometimes even in the same bunch of plants, from typical *C. sinuosa*, as Saunders regards it, to typical *Scytosiphon bullosus* as Saunders has figured and distributed it. The series of figures (pl. 18, f. 13–15) drawn from Californian material, shows how the lobes of this form take on various shapes, and when we have one or more long finger-shaped lobes far exceeding the others, then, we have a plant approximating very nearly, at least, to the type of *Scytosiphon bullosus*. A similar form is described below under *Soranthera ulvoidea* P. & R.

Scytosiphon lomentarius (Lyngbye) J. Agardh.

On rocks and stones in the litoral zone. Distributed along the whole western coast of North America: Port Clarence, Alaska, *Kjellman* (1889, p. 50); St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5808! (Setchell, 1889, p. 591); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3282!; Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 19, under *Chorda filum* var. *fistulosa*); Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5087!; Shumagin Islands, Kukak Bay, Yakutat Bay, Glacier Bay, Sitka, and Annette Island, Alaska, *Saunders* (1901, p. 421); Port Renfrew, B. C., *Tilden*, No. 347b!, under *Chordaria attenuata;* San Juan Island, Wash., *Tilden*, No. 347a!, under *Chordaria attenuata;* west coast of Whidbey Island, Wash., *N.L.G.*, No. 100!; Friday Harbor, San Juan Island, Wash., *Tilden*, No. 246!

Scytosiphon lomentarius f. **complanatus** Rosenvinge.

Glacier Bay and Juneau, Alaska, *Saunders* (1901, p. 421).

Phyllitis fascia (Mueller) Kuetzing.

On stones in the lower litoral zone. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4016!; Uyak Bay, Kadiak

Island, Alaska, *W.A.S. and A.A.L.*, Nos. 5075!, 5098!; Kukak Bay, Cook Inlet, Yakutat Bay, Glacier Bay, and Annette Island, Alaska, *Saunders* (1901, p. 421); Esquimalt, B. C., *Harvey* (1862, p. 167); west coast of Whidbey Island, Wash., *N.L.G.*, No. 200!

Soranthera ulvoidea P. & R.

On *Odonthalia floccosa* and *Rhodomela Larix*, in the lower litoral zone. Yakutat Bay, Alaska, *Saunders* (1901, p. 422); Sitka, Alaska, *Postels and Ruprecht* (1840, p. 19); Wrangell, Alaska, and Victoria, B. C., *Saunders* (1901, p. 422); Port Renfrew, B. C., *Butler and Polley*, No. 104.

The plants noted here are known to us only from the references and are placed under the species without comment. The plants examined are grouped under two forms as given below.

Soranthera ulvoidea f. typica Setchell and Gardner nom. nov.

Habitat same as preceding. West coast of Whidbey Island, Wash., *N. L. G.*, No. 107!; Friday Harbor, San Juan Island, Wash., *Tilden*, No. 245!

The typical form of this species as described by Postels and Ruprecht is nearly regular in outline, either oval ellipsoidal, or very nearly globular. This is the plant figured by Kjellman (1889, pl. 7, f. 4, 5) and also, less typically, by Saunders (1898, pl. 29, f. 4, 5) and distributed by the latter in Collins, Holden and Setchell, P. B.-A., No. 417. The two specimens noted above also belong to the type as it seems to us. The more common northern form is the following.

Soranthera ulvoidea f. difformis Setchell and Gardner f. nov.

Frond variously and deeply lobed, sometimes very irregularly so.

On same hosts as the two preceding. East shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3276!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4073!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5081!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5145!; Yakutat Bay, Alaska, *Rev. Albin Johnson*!

This form seems to prefer impure water, either brackish or muddy.

Family STRIARIACEÆ.

Phlœospora tortilis (Turner) Areschoug.

On stones, in quiet and somewhat brackish water. Golofnin Bay, Alaska, *R. C. McGregor*, Nos. 5668!, 5676!; lagoon near Summer Bay, Unalaska, Alaska, *W. A. S. and A. A. L.*, No. 4069!, in Collins, Holden and Setchell, No. 987!, under *Stictyosiphon tortilis*.

No. 5676 has excellent sporangia, the other numbers are largely sterile.

Phlœospora subarticulata Areschoug.

Port Clarence, Alaska, *Kjellman* (1889, p. 50).

By some authors, this species is not considered distinct from the preceding.

Striaria attenuata (Agardh) Greville.

Orcas Island, Wash., and Vancouver, B. C., *Harvey* (1862, p. 167).

The reference quoted above is the only reason known to us for including this species in our account.

Family DESMARESTIACEÆ.

Desmarestia viridis (Mueller) Lamouroux.

On stones in the upper sublitoral region. Captains Bay, Unalaska, Alaska, *A. A. L.*, No. 5015!; Prince William Sound and Glacier Bay, Alaska, *Saunders* (1901, p. 422); Esquimalt, B. C., *Harvey* (1862, p. 164).

The occurrence of this species in our territory is not altogether satisfactorily known to us. No. 5015 seems to be this species rather than *D. aculeata* f. *media* (Agardh) J. Agardh, which it resembles in its older states. This resemblance and lack of careful study of the two forms, makes it uncertain at times, to which species the references refer. Saunders says that it is not uncommon, but less abundant than *D. aculeata*. *D. viridis* f. *major* P. & R. (1840, p. 13) seems from the description to be a form of the following species. It was collected at Unalaska.

Desmarestia aculeata (L.) Lamouroux.

Floating, or attached to stones in the upper sublitoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 50); St. Paul Island, Alaska, *Greeley and Snodgrass*!, (Setchell 1899, p. 591); Kyska Island, Alaska, *Townsend*, No. 5774!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 4036!, 4065!; Shumagin Islands, Alaska, *Saunders* (1901, p. 422); Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5136a!; Kukak Bay, Yakutat Bay, Sitka, and Wrangell, Alaska, and Victoria, B. C., *Saunders* (1901, p. 422); Esquimalt, B. C., *Harvey* (1862, p. 164. in 8–10 fathoms of water); Puget Sound, *Bailey and Harvey* (1862, p. 160); Whidbey Island, Wash., *N.L.G.*, No. 118!; North Bay, San Juan Island, Wash., *Tilden*, No. 352!

The specimens from the localities mentioned above, are all, or at least as far as the specimens examined are concerned, of the typical form or very near it. Some of them are rather broad, but, unless we subdivide the species under several forms, they are to be included here and not at all under the following form which is decidedly distinct.

Desmarestia aculeata f. media (Agardh) J. Agardh.

Floating, probably coming from the sublitoral zone, where it grows on shells and rocks. Captains Bay, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4087!; Unalaska, Alaska, *Agardh*, (1821, pl. 16, under *Sporochnus medius*), *Postels and Ruprecht* (1840, p. 13, under *D. intermedia*), *Ruprecht* (1851, p. 375, under *Spinularia media*); Unga, Alaska, *J. B. Downing*!; Douglas, Alaska, *Eldred Jenne*!; Sitka, Alaska, *Ida M. Rodgers*, No. 5728!; Minnesota Reef, San Juan Island, Wash., *Tilden*, No. 353!, under *D. viridis*.

The plants considered under this form are so distinct from the ordinary typical *D. aculeata*, that we are sorely tempted to restore them to specific rank. They lack the flattened character of the fronds of the type, the stem and branches being nearly, if not quite, terete. The opposite branches give this form the appearance of *D. viridis*, but the substance is much more cartilaginous than in that species and the spines of *D. aculeata* are present, although not nearly so pronounced as in that species.

Cross sections of the larger branches show a structure intermediate between that of the two species mentioned. The *D. intermedia* P. & R. seems to be made up of this form as Agardh pictures it and other forms of *D. aculeata*. Postels and Ruprecht (1840, p. 13) mention a variety *teretifolia* as occuring at Sitka and another variety, *fuscescens*, as occurring on the Alaskan Peninsula. The former seems likely to be the same as our plant, but the latter is less likely to be placed here; probably to be placed rather with the type of *D. aculeata*. Kuetzing's figures (1859, pl. 96) of *D. intermedia* are evidently not of this form, nor is the *D. media* of the same author (loc. cit., pl. 95), but the *D. hybrida* (loc. cit., pl. 93) may possibly be. The f. *media* certainly needs more study and particularly the young plants, none of which are available to us.

Desmarestia ligulata (Lightfoot) Lamouroux.

In ten fathoms of water. Burrard's Inlet, B. C., *Harvey* (1862, p. 164).

Harvey says that the type and var. *herbacea* were found in the same locality. Very few, if any, of the plants which we have been able to examine correspond to the slender form from European localities which may more properly stand for the type, but are to be counted under the following form. The variation of width in this species and the distinctness of the veining, is very great, at least as far as the plants of the Pacific Coast of North America are concerned.

Desmarestia ligulata f. herbacea (Turner) J. Agardh.

Northwest coast of North America, *Turner* (1809, p. 77, pl. 99, under *Fucus herbaceus*); Norfolk Sound (near Sitka), Alaska, *Postels and Ruprecht* (1840, p. 13, under *Desmia herbacea*); Burrard Inlet, B. C., *Harvey* (1862, p. 164); Oak Bay, Victoria, B. C., *Tilden*, No. 244!; Port Renfrew, B. C., *Butler and Polley*, No. 7; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 85!, 120!

This form is plentiful in the region of Puget Sound, but is apparently rarer to the northward. It varies very much in width. One of us (W.A.S.) has noted it at Esquimalt, B. C., cast ashore in fragments several meters long and full 30 centimeters wide.

These plants are the widest we have ever seen or found mentioned. This form grows in abundance on the coast of Central California, but while reaching a considerable width, the plants are seldom over 8 or 10 centimeters wide.

FAMILY DICTYOSIPHONACEÆ.

Dictyosiphon hippuroides (Lyngbye) Kuetzing.

On rocks, lower litoral zone. St. Paul Island, Alaska, *Greeley and Snodgrass*! (Setchell, 1889, p. 591); near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*!

Dictyosiphon fœniculaceus (Hudson) Greville.

On stones, middle and lower litoral zone. Alaska, *Harvey*, (1872, p. 463); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3275!; Unga, Alaska, *A.A.L.*, No. 5049!; Shumagin Islands, Alaska, *Saunders*, (1901, p. 422); Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5091!; Prince William Sound, Alaska, *Saunders*, (1901, p. 422); Orca, Alaska, *W.A.S. and A.A.L.*, No. 5163!; Glacier Bay, Juneau, Wrangell, and Annette Island, Alaska, *Saunders*, (1901, p. 422).

Dictyosiphon fœniculaceus f. Americanus Collins.

Golofnin Bay, Alaska, *R. C. McGregor*, No. 5670!

Dictyosiphon Chordaria f. gelatinosa Stroemfelt.

On rocks or mud, in the middle and lower litoral zone. Dutch Harbor, Amaknak Island, Bay of Unalaska, Alaska, *A.A.L.*, No. 5008!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 212!

FAMILY ELACHISTACEÆ.

Elachista lubrica Ruprecht.

On *Rhodymenia palmata* in the litoral zone. Prince William Sound, Alaska, *Saunders* (1901, p. 423); Orca, Alaska, *W.A.S. and A.A.L.*, No. 5156!; Yakutat Bay, Alaska, *Saunders* (1901, p. 423), and in Collins, Holden and Setchell, P. B.-A., No. 828!, *Rev. Albin Johnson*, No. 5717!; Glacier Bay and Wrangell, Alaska, *Saunders* (1901, p. 423).

Elachista fucicola (Velley) Areschoug.

On *Fucus vesiculosus.* Sitka, Alaska *Ruprecht*, (1851, p. 389).

The only reference is that of Ruprecht, who says in connection with *E. lubrica*: "Aus dem nördlichen stillen Ocean ist mir von dieser Gattung bisher nur *E. fucicola Aresch.* auf *Halidrys vesiculosa* von Sitcha bekannt."

Family CHORDARIACEÆ.

Myrionema strangulans Greville.

On various membranous algæ. On blades of Nereocystis, Cormorant Rocks, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5131!, in Collins, Holden and Setchell, P. B.-A., No. 924!, under *M. vulgare*; on Ulva, Sitka, Alaska, *Saunders* (1901, p. 423); on *Hedophyllum sessile*, Victoria, B. C., *Tilden*, No. 356! under *Phycocœlis fecunda*; on Nereocystis, west shore of Whidbey Island, Wash., *N.L.G.*, No. 546!; on Ulva, East Sound, Orcas Island, Wash., *N.L G.*, No. 529a!

Eudesme virescens (Carmichael) J. Agardh.

Not uncommon on rocks and eel grass in the litoral and sublitoral zones. Shumagin Islands, Prince William Sound, Glacier Bay, and Sitka, Alaska, *Saunders* (1901, p. 423).

Castagnea divaricata (Agardh) J. Agardh.

On mud flat, lower litoral zone. East Sound, Orcas Island, Wash., *N.L.G.*, Nos. 483!, 566!

The habit and structure resemble very strongly those of this species as it occurs on the coast of New England, but the paraphyses have fewer cells. They do have, however, the much swollen end cell characteristic of this species.

Leathesia difformis (L.) Areschoug.

On algæ of various kinds and on rocks, in the litoral zone. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5080!; Yakutat Bay, Sitka, Wrangell, and Annette Island, Alaska, and Victoria,

B. C., *Saunders* (1901, p. 423); west coast of Whidbey Island, Wash., *N.L.G.*, No. 284!; Traeyton, Kitsap County, Wash., *Tilden*, No. 243!, but the last specimen is so poor that it is scarcely determinable.

Mesogloia simplex Saunders.

On worn plants of *Chordaria abietina* Ruprecht. Sitka, Alaska, *Saunders* (1901, p. 423); Gonzales Point, Victoria, B. C., *Tilden*, No. 348 (fide *Saunders*, 1901, p. 424); Port Renfrew, B. C., *Butler and Polley*, No. 9!

This curious species needs farther study. We have seen only one specimen, communicated to us by Mr. Collins.

Mesogloia Andersonii Farlow.

On rocks in the lower litoral or upper sublitoral zone. Port Renfrew, B. C., *Butler and Polley*, Nos. 12 and 41; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 116!, 116A!, 468! and in Collins, Holden and Setchell, P. B.-A., No. 925!; San Juan Island, Wash., *Tilden*. No. 349!, under *Chordaria flagelliformis*.

The plants of this species become very gelatinous very soon after they are taken from the water. Miss Tilden's plant has been referred here by Farlow and represents the typical structure of this species, but in our copy of the American Algæ the habit is dwarfed and somewhat less regularly pinnate than in the more typical specimens. Saunder's "*Liebmannia sp.*" (1901, p. 424, pl. 49) seems to us to belong to this species. His habit-figure resembles the habit of Miss Tilden's plant, while the structure agrees very well with that of the type. It was collected at Sitka, Alaska.

Chordaria flagelliformis f. **typica** Kjellman.

On rocks, upper sublitoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 48); St. Paul Island, Alaska, *Greeley and Snodgrass*, Nos. 5797!, 5798!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 4027!, 5012!; Unga, Alaska, *A.A.L.*, Nos. 5048!, 5049!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, Nos. 5101!, 5082!; Yakutat Bay, Alaska, *Saunders* (1901, p. 424), *Rev. Albin Johnson*, No. 5715!; Glacier Bay and Sitka, Alaska, *Saunders* (1901, p. 424).

All the plants mentioned above which have been seen by us belong to this form, the only difference between them being in thickness. Some are very much more robust than others. For some unexplained reason this species seems to be restricted, on our coast, to the shores of Alaska, while on the eastern coast of North America it descends into very much warmer waters.

Chordaria flagelliformis f. ramusculifera Kjellman.

In the sublitoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 48).

This form is near to, if not identical with, *C. flagelliformis* f. *densa* Farlow.

Chordaria flagelliformis f. Chordæformis Kjellman.

Upper sublitoral zone. Konyam Bay, Siberia, *Kjellman* (1889, p. 48).

Although this form does not quite enter our limits, it is mentioned here since the species mentioned above as *Myelophycus intestinalis* Saunders seems to come very near to it. The relationship at present seeming to exist between Chordaria, Myelophycus, and Analipus certainly needs more careful consideration and study, as will be emphasized farther under the next species.

Chordaria abietina Ruprecht. Plate 18.

On rocks, at or just below low water mark. Dutch Harbor, Amaknak Island, Bay of Unalaska, Alaska, *R. C. McGregor*, No. 5692!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4058!; Shumagin Islands, Alaska, *Saunders* (1901, p. 424); Cormorant Rocks, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5132!; Prince William Sound and Sitka, Alaska, *Saunders* (1901, p. 424); Victoria, B. C., *Tilden*, No. 348!; Port Renfrew, B. C., *Butler and Polley*, No. 43!; Whidbey Island, Wash., *N.L.G.*, No. 31!

This species is probably not uncommon on the western coast of North America from just above Point Conception, California, to Unalaska, and even on to the Asiatic shores. The description must be amended in one important respect, and that is as regards the base. The base is not made up of a crust formed by the overlapping disks of a group of plants, but there is a distinct,

horizontal, lobed and parenchymatous thallus, from which many plants arise. The details are well shown in the series of figures of this species on plate 18. The figures are drawn from specimens from near Pacific Grove, California, where one of us had the opportunity of studying a very complete series of stages of growth. But evidence that these plants are not exceptional in this respect has been obtained elsewhere in California and on the Alaskan Coast. The existence of a similar horizontal thallus in *Chordaria flagelliformis* is suspected by us, at least in a more or less reduced state (cf., e.g., No. 482, P. B.-A., *C. flagelliformis* f. *densa* Farlow) and likewise in *Myelophycus cæspitosus* Kjellman, (according to Kjellman's figure, 1893, f. 1, and Okamura's specimen, 1899, No. 44). The horizontal thallus of *Analipus fusiformis* Kjellman seems very similar to that of *C. abietina*.

Analipus fusiformis Kjellman.

In the lower litoral zone, on rocks. St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5795!, *Townsend*, No. 5782! (Setchell, 1899, p. 591).

The plants included under the present species seem to agree with the description and figures of Kjellman's plant from Bering Island on the other side of the Bering Sea. The basal portion is not very conspicuous, but is as marked as in the type. Kjellman has placed this genus with *Cæpidium* J. Agardh in a special section of the family Chordariaceæ on account of the possession of a horizontal thallus, but, as shown above, this character is found also in *Chordaria abietina* and perhaps in other species as well as in *Myelophycus cæspitosus* Kjellman.

FAMILY SPOROCHNACEÆ.

Carpomitra Cabreræ (Clem.) Kuetzing.

"Fuca Strait," B. C., *Harvey* (1862, p. 164).

Harvey says that Dr. Lyall collected a single specimen of this species in fruit, which agrees well with British specimens. It seems strange that none of the collectors in this region have seen it since.

Family RALFSIACEÆ.

Ralfsia verrucosa (Areschoug) J. Agardh.

On stones in the middle and lower litoral zones. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4011!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 192!

Both the plants placed under this species are sterile, but they seem otherwise to belong with this species rather than under either of the following.

Ralfsia deusta (Agardh) J. Agardh.

On rocks and stones middle and lower litoral zones. St. Lawrence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 47); near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4059! (sterile), *Postels and Ruprecht* (1840, p. 20, under *Padina deusta*); Kukak Bay, Orca, and Sitka, Alaska, *Saunders* (1901, p. 424).

Ralfsia clavata (Carmichael) Farlow.

On small stones in the middle litoral zone. Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4012!

The specimens noted here have fine unilocular sporangia and seem to agree well with this species.

Family LITHODERMATACEÆ.

Lithoderma fatiscens Areschoug.

On stones in the lower litoral and upper sublitoral zones. Port Clarence, Alaska, *Kjellman* (1889, p. 49); Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L*!

The specimens are all sterile but the determination seems safe.

Lithoderma lignicola Kjellman?

On piles in the litoral zone. St. Michael, Alaska, *W.A.S.*, No. 5245x!

The specimens referred here are sterile, but they agree fairly well with Kjellman's description and figures (1883, p. 256, pl, 26, f. 8–11).

FAMILY LAMINARIACEÆ.

Chorda filum (L.) Lamouroux.

On stones in the upper sublitoral zone. Safety Harbor, near Cape Nome, Alaska, *Newhall and Rhodes*, No. 5790!; Golofnin Bay, Alaska, *R. C. McGregor*, No. 5669!; St. Michael, Alaska, Herb. *D. C. Eaton*, No. 11!; Popof Island and Prince William Sound, Alaska, *Saunders* (1901, p. 424); Sitka, Alaska, *Postels and Ruprecht* (1840, p. 19, under *C. filum* var. *coriacea*); Strait of Juan de Fuca, B. C., *MacMillan* (1902, p. 219).

This species, which is common on the coasts of northern and northwestern Europe and the northeastern coasts of North America, is not abundant at any locality in our territory, so far as our present information is concerned. Ruprecht (1851, p. 368) says that it is probably plentiful in the Ochotsk Sea. Harvey (1872, p. 463) reports it from Alaska without specific locality. The locality farthest south is the one reported by Professor Conway MacMillan in the neighborhood of Puget Sound, but it is not at all plentiful.

Saccorhiza dermatodea (De la Pylaie) J. Agardh.

Although this species has been mentioned several times by the older writers, under the name of *Laminaria dermatodea*, there seems to be little doubt, but that some species of digitate Laminaria has been confounded with it in every case. It seems doubtful whether Harvey's *Laminaria dermatodea* (1862, p. 166) from the Strait of Juan de Fuca and from Esquimalt, B. C., can really be this species. J. G. Agardh refers Harvey's plant (1867, p. 18) to his *L. fissilis*.

Laminaria Bongardiana P. & R.

Saunders (1901, p. 429) says of this species, that it is abundant from Sitka to the Shumagin Islands, and gives as special localities, Kukak Bay, Prince William Sound, and Sitka. He does not separate the species into forms as Areschoug and Kjellman have done, and as we have attempted to do below. As we understand *L. Bongardiana*, it is a species with the habit and color of *L. digitata*, but with a circle of mucilage ducts in the outer cortex of the stipe, and with mucilage ducts in the blade just under the outer layers of cells.

Laminaria Bongardiana f. elliptica Kjellman.

On rocks, on exposed coasts, at low water mark. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3245!, in Collins, Holden and Setchell, P. B.-A., No. xxviii!; Orca, Alaska, *W.A.S. and A.A.L.*, No. 5155!; Yakutat Bay, Alaska, *Rev. Albin Johnson*!; Sitka, Alaska, *W.A.S. and A.A.L.*, No. 5203!

Kjellman has substituted this form name for Areschoug's form name *normalis*, and it has seemed best to follow him in it. Areschoug's plant probably came from Sitka (cf. Areschoug, 1883, p. 5). It is probably, also, the *palmata*-form of Postels and Ruprecht (1840, p. 10) from Kamtschatka

Laminaria Bongardiana f. oblonga Setchell and Gardner f. nov.

Differs from the preceding form in the narrower and undivided or only slightly divided blade, and from the f. *tæniata* in the obtuse or even slightly cordate base.

On timbers of a float. Sitka, Alaska, *W.A.S. and A.A.L.*, No. 5202a!

Laminaria Bongardiana f. bifurcata P. & R.

With the *f. elliptica*, when found growing. Near Iliuliuk, Alaska, *W.A.S.*! (specimen not preserved); floating, Unga, Alaska, *A.A.L.*, No. 5061a!

This is only a case of regeneration after an unusually deep split passing down from the blade into the stipe.

Laminaria Bongardiana f. tæniata (P. & R.) Kjellman.

With the f. *elliptica*, on rocks exposed to the waves, forming a fringe at low water mark. West shore of Amaknak Island, Unalaska, Alaska. *W.A.S. and A.A.L.*, No. 3245a!

This is simply a narrow, more or less undivided form with sharply cuneate base.

Laminaria Andersonii Farlow.

On rocks in the upper portion of the sublitoral zone. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 110a!, 275!

This species may be told from the other digitate species of our territory by the position of the circle of mucilage ducts which are

in the inner cortex, one-third to one-half way between the periphery and the medulla. No. 275 is a plant referred to *Eisenia arborea* by Saunders, a species not seen by us north of the central coast of California.

Laminaria Ruprechti (Areschoug) DeToni.

Sitka, Alaska, *Ruprecht*, (fide Areschoug, 1883, p. 4).

The proposer of this species had only a single specimen, and as far as we know, there have been no others found, or at least, identified. In looking over the description, we feel that it may be that *L. Ruprechti* is the same as our *L. bullata* f. *cuneata*, but since we have no opportunity of consulting the type-specimen, we must leave the disposition of our forms as given.

Laminaria fissilis J. Agardh.

This species evidently was founded on the *L. digitata* f. *partita* Postels and Ruprecht (1840, p. 10), a Kamtschatkan plant. The proposer says also that it includes the *L. dermatodea* of Harvey's List. From this, it appears that it occurs also on the shores of Vancouver Island at the Strait of Juan de Fuca. There seems to be some difference of opinion as to the occurence of mucilage ducts in the stipe. Kjellman says (1883, p. 236) that the stipe lacks these structures, while Rosenvinge (1894, p. 88) says that they are usually present in one or two circles. We have never seen any specimens certainly belonging to this species, but we suspect that we have forms of it under *L. bullata*. The latter species, however, has bullæ on the blade, which are not mentioned in any description of *L. fissilis*.

Laminaria nigripes J. Agardh.

Kjellman (1889, p. 45) has found this species on Bering Island, Siberia, and represented by several forms. We have not been able to determine exactly whether this species occurs in our territory or not, but we suspect that future study and comparison may result in transferring some, if not all, of the forms credited by us, and perhaps also by other authors, to the following species, from it to this one. They all differ from the descriptions of *L. nigripes*, however, in having bullæ on the blade.

Laminaria bullata Kjellman.

In the sublitoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 46); Prince William Sound and Sitka, Alaska, and Puget Sound, *Saunders*, (1901, p. 428).

We have seen no authentic specimen of this species and can quote only the published references to it. We have a number of forms, decidedly diverse in habit and somewhat in structure, which we cannot refer elsewhere, and consequently, have placed them provisionally under form names connected with *L. bullata*, as follows.

Laminaria bullata f. **angusta** Setchell and Gardner f. nov.

Stipe short, 1–2 cm. long, terete or slightly flattened above. Blade 15–45 cm. long, 3–5 cm. wide, cuneate at the base, usually more or less falcate, with a row of deep bullæ within each margin. Mucilage ducts in the stipe in a dense circle close to the periphery, elongated radially and with conspicuous secreting cells; in the blade rather large, about one-third the way between the surface and the distinctly marked off and wide medulla.

Abundant in the upper sublitoral zone. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 109!, 124!, 158!. 681!

This is the plant figured by Kjellman (1889, pl. 2, f. 5) as an example of a young specimen from Bering Island. It does not seem to change its character with age and in general habit resembles the similar form of *L. saccharina*. It is never divided so far as our specimens go. The mucilage ducts in the stipe are sometimes scanty above, but are always more or less abundant below. Were it not for the very complete series of connecting forms, it would seem ridiculous to refer this form to a digitate species.

Laminaria bullata f. **subsimplex** Setchell and Gardner f. nov.

Stipe short, 4–8 cm. long, terete below, somewhat compressed above, stout. Blade 50–150 cm. long, 10–15 cm. wide, very dark and thick, usually with a more or less distinct row of bullæ within each margin, particularly in younger plants, commonly entire or split one-third or one-half the way down into two, or at most few and broad segments. Mucilage ducts in the stipe, forming

a dense circle just under the periphery; in the blade rather large, about half way between the surface and the distinctly marked off and wide medulla.

In the sublitoral zone. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 157b!, 159!, and in Collins, Holden and Setchell, P. B.-A., No. XXIX!

Near to the preceding, but a larger plant, with bullæ less marked or even absent, marking a transition to the broader and and distinctly digitate forms of the species.

We are inclined to refer Miss Tilden's No. 239, labelled *L. digitata*, from Port Renfrew, B. C., to this form, although only a portion of the plant is represented by the specimen distributed.

Laminaria bullata f. **cuneata** Setchell and Gardner f. nov.

Stipe short, 1–2 cm. long, soon very much flattened. Blade 45–90 cm. long, 10-25 cm. wide, sharply cuneate at the base, broadening out above, split into one to several broader or narrower divisions which usually extend to the very base, smooth for the most part. Mucilage ducts as in the last.

In the sublitoral zone, West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 69!, 110b!

A form usually decidedly distinct from the preceding and approaching the following. This is the only form which practically entirely lacks the bullæ in the adult form.

Laminaria bullata f. **amplissima** Setchell and Gardner f. nov.

Stipe 2–4 cm. long, soon flattened. Blade 100–280 cm. long, 40–150 cm. wide, broadly cuneate to almost cordate at the base, broader above, split more or less deeply into few and broad segments, with a fairly distinct row of large bullæ within each margin. Mucilage ducts in the stipe in usually more or less incomplete circles just within the periphery; in the blade large, with conspicuous masses of secreting cells, one-third to one-half the way between the surface and the wide and distinct medulla.

On piles or floating wood in the upper sublitoral zone, in quiet water. Sitka, Alaska, *Ida M. Rodgers*, No. 5729!; Friday and Roach Harbors, San Juan Island, Wash., *N.L.G.*, Nos. 277!, 680!, 683?

The type of this form is No. 680 mentioned above. The plant is near to the preceding form, but while that is a plant of the exposed shores and consequently less ample, the present form is a plant of the more quiet waters where the opportunities are given to increase in width with the result that some of the plants are certainly gigantic for this species. In older plants the whole surface is bullate. No. 683 is a shorter, less ample plant with a distinctly cordate base with the mucilage ducts in the blade of moderate size and close under the surface, but with the marginal bullæ very distinct. With the exception of the bullæ it might pass very well for a specimen of *L. atrofulva* J. Agardh.

Laminaria dentigera f. **brevipes** Setchell and Gardner f. nov.

Stipe 10–15 cm. long, nearly cylindrical but somewhat flattened above; otherwise similar to the next.

Agattu Island, Alaska, *Townsend*, No. 5763!; Kyska Island, Alaska, *Townsend*, No. 5771!

The form described here agrees fairly well with Kjellman's figure (1889, pl. 2, f. 10) in habit and is fairly distinct from the following form which, however, seems also to belong under Kjellman's species. The stipe in f. *brevipes* is short and stout as compared with f. *longipes*, and not so noticeably compressed above. The whole plant seems thicker and denser. The mucilage ducts are present in the stipe in a dense circle just under the surface tissues, are elongated radially, and have clumps of secreting cells at the inner end. In the blade, the mucilage ducts are scanty, in fact we supposed at first that there were none present, but they are present and answer well to Kjellman's description.

Laminaria dentigera f. **longipes** Setchell and Gardner f. nov.

Stipe 25–50 cm. long, soon compressed, and above very decidedly flattened. Otherwise similar to the preceding.

On stones in the lower litoral and upper sublitoral zones. Unga, Alaska, *A.A.L.*, No. 5058!; Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5072!

This form looks very much like *L. digitata* f. *typica* with the cuneate base. The mucilage ducts in the stipe, however, distin-

guish it. The mucilage ducts in the blade appear to be somewhat more abundant than in the preceding form, but are not very common even here.

Laminaria digitata (L.) Lamouroux.

Laminaria stenophylla Harvey.

These species have been credited to our territory by the older writers, but it seems fairly certain that these species, as understood at present, are not known from our limits with any certainty.

Laminaria longicruris De la Pylaie.

This species is mentioned by Postels and Ruprecht (1840, p. 10) as being rare in the Northern Pacific Ocean. It has not been met with by any other writer.

Laminaria cuneifolia J. Agardh.

North Pacific Ocean, on the shores of Asia and America, *J. G. Agardh* (1867, p. 10); Popof Island, Alaska, *Saunders* (1901, p. 429).

We have seen the plant of Saunders, but do not feel certain of the determination. The species seems to be distinguished from *L. saccharina* chiefly by the mucilage ducts in the stipe, at least as Agardh has described it. From Saunders's description, his *L. saccharina forma a* (1901, p. 429), since it is said to have mucilage ducts in both stipe and blade, should be referred here. It is given a range from the Shumagin Islands to Wrangell, Alaska.

Laminaria solidungula J. Agardh.

In the sublitoral zone. Yakutat Bay, Kukak Bay, and Popof Island, Alaska, *Saunders* (1901, p. 429).

The present species has not occurred to us in the territory covered in this account. We have supposed at several times that we had discovered it, but the specimens have always proved to be young plants of *Cymathære triplicata*, whose resemblance to *L. solidungula* at this stage is often very striking.

Laminaria longipes Bory.

Agattu Island, Alaska, *Townsend*, No. 5761!; Kyska Island, Alaska, *Townsend*, No. 5768!; St. Paul Island, Alaska, *Ruprecht*

(1851, p. 232), *Greeley and Snodgrass*, No. 5806! (Setchell, 1899, p. 591).

The present species resembles very strongly *L. Sinclairii* (Harvey) Farlow of the Central Californian coast in its habit and in its possession of a creeping rhizome, but differs from it in not having mucilage ducts in the stipe.

Laminaria saccharina (L.) Lamouroux.

Forms of the true *L. saccharina* are fairly abundant on the coast from Puget Sound to the Alaskan Peninsula. It is not known to enter the Bering Sea or to extend to the southward of Cape Flattery in Washington, a distribution which is puzzling from what we know of the species on the coasts of Europe or those of Eastern North America. The various older and modern references are fairly readily placed under the forms described, except the plants of Harvey (1862, p. 166) collected at Esquimalt, B. C.

Laminaria saccharina f. linearis J. Agardh.

On wood and stones, upper sublitoral zone. Unga, Alaska, *J. B. Downing*, No. 5788!; Uyak Bay, Kadiak Island, Alaska, *W. A. S. and A. A. L.*, No. 5136!; Kukak Bay and Prince William Sound, Alaska, *Saunders* (1901, p. 429, as to forma b only); Orca, Alaska, *W. A. S. and A. A. L.*, No. 5154!; Sitka, Alaska, *Postels and Ruprecht* (1840, p. 10, as to f. *cuneata* only), *W. A. S. and A. A. L.*, No. 5202!; west coast of Whidbey Island, Wash., *N. L. G.*, Nos., 160!, 305!

Under this name we have included the narrower, thicker, less ruffled form with few or no bullæ. It seems to be a form of the colder waters or the colder seasons.

Laminaria saccharina f. membranacea J. Agardh.

On rocks and stones, or at times on other large algæ, in the upper sublitoral zone. Douglas, Alaska, *Eldred Jenne*, No. 649!; Sitka, Alaska, *Postels and Ruprecht* (1840, p. 10, under *L. latifolia*): Fairhaven, Wash., *N. L. G.*, No. 75!; Friday Harbor, San Juan Island, Wash., *N. L. G.*, No. 304!; Port Orchard, Kitsap County, Wash., *Tilden*, No. 240!

Both the preceding forms are included under the f. *normalis*

Setchell (1900, p. 122) and may perhaps be viewed as subforms or states under that form. We feel that perhaps it is well to separate and note them separately in this account, but we regard them as colder and warmer water states of the ordinary form of the species. Certainly in some waters the summer form of a plant would be placed under f. *membranacea* while the winter form of the same plant would be placed under f. *linearis*. Where the water is always cold, the species may possibly assume only the latter shape.

Laminaria saccharina f. **complanata** Setchell and Gardner f. nov.

Stipe long, up to 50 cm., terete below, soon flattened (20 mm. wide and 3 mm. thick about two-thirds the way up), without mucilage ducts. Blade 80–100 cm. long, 40–50 cm. wide just above the base, ample, ruffled, with base decidedly cordate. Mucilage ducts in the blade large and extremely abundant, just under the surface layer of cells.

Found in a single locality, growing on piles, in quiet water, just below low water mark. Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 682!

A very distinct form, easily recognized by its decidedly flattened stipe.

Hedophyllum sessile (Agardh) Setchell.

Attached to rocks in the middle and lower litoral zones. Yakutat Bay, Alaska, *Saunders* (1901, p. 429); Strait of Juan de Fuca, *Harvey* (1862, p. 167, under *Laminaria apoda*); Victoria, B. C., *Tilden*, No. 344! under *Laminaria sessilis*; Esquimalt, B. C., *W.A.S.*, No. 1877!; Port Renfrew, B. C., *Butler and Polley*, No. 60!; west coast of Whidbey Island and of San Juan Island, Wash., *N.L.G.*, No. 275!, etc.

The first description of this species was by C. A. Agard (1824, p. 270), as from the southern seas. No more definite locality was known, until the identity between this species and the *L. apoda* of Harvey was established by J. G. Agardh. At present the species is known to range from Fort Ross, California, to Yakutat Bay, Alaska. *H. sessile* is the type of the genus and not *H. subsessile* as stated by Saunders (1901, p. 430). The

young plants have a short stipe, while the older plant becomes cucullate at the base of the blade, which sends out hapteres. This continues as the plant grows older, the blade continuing to expand at the base, to form new rows of hapteres, thus becoming more sessile and prostrate in this region, wider and more split above, until it forms clumps of sessile fronds sitting upon masses of clustered hapteres. The plants of the lower parts of its habitat have smooth blades, but those of the upper parts often have the blades bullate and irregularly rugose. The sori form indefinite patches over the base of the entire frond.

Hedophyllum subsessile (Areschoug) Setchell. PLATE 20.

On rocks, usually forming a zone in the middle litoral zone. Kyska Island, Alaska, *Townsend*, No. 5770!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3286!, *L. E. Hunt*, No. 3250!, in Collins, Holden and Setchell, P. B.-A., No. XXVII!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5078!; Kukak Bay, Alaska, *Saunders* (1901, p. 430); Prince William Sound, Alaska, *Saunders*, No. 259!; Yakutat Bay, Alaska, *Saunders*, No. 218!; Puget Sound, *Saunders* (1901, p. 430).

The present species is widely diverse from any form which can be legitimately reckoned under *L. Bongardiana*, to which Areschoug referred it as a form. It comes near to *Hedophyllum sessile* in its earlier stages of growth, but soon departs from that species in that the central portion of the blade wears away, leaving the bases of the blade on each side of the original short stipe as thickened, rhizome-like, creeping structures bearing the blades, or half blades, at their tips (cf. pl. 20). The peculiar dying away of the center of the blade to the very base and the consequent thickening of the basal margins, is known in Eisenia (cf. Setchell, 1896) and in Thalassiophyllum as described below. The present species lacks the scrolls or auricles at the base of the blade characteristic of Arthrothamnus. The development of the members of the last genus is not known as yet, and may be quite different from that of Hedophyllum, if one may judge from specimens of the adult plants. While we have noted localities

for this species outside of Bering Sea, the plants are all young and do not show the characteristic rhizomes, and may be forms of *L. Bongardiana* or *L. bullata.*

Cymathære triplicata (P. & R.) J. Agardh.

On rocks and stones in the upper sublitoral zone. North Pacific Ocean, *Postels and Ruprecht* (1840, p. 10); Unalaska Alaska, *Ruprecht* (fide Areschoug, 1883, p. 20); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W. A. S. and A. A. L.*, No. 3289!, in Collins, Holden and Setchell, P. B.-A., No. XXXIIIa!; Shumagin Islands to Puget Sound, *Saunders* (1901, p. 430); Karluk, Kadiak Island, Alaska, *W. A. S.*, No. 5061!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W. A. S. and A. A. L.*, No. 5118!; Orca, Alaska, *W. A. S. and A. A. L.*, No. 5177!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5716!; Douglas, Alaska, *Eldred Jenne*, No. 648!; Victoria, B. C., *Tilden*, No. 343!; Esquimalt, B. C., *W. A. S.*, No. 1872!; west coast of Whidbey Island, Wash., *N. L. G.*, No. 88!, in Collins, Holden and Setchell, P. B.-A., No. XXXIIIb!; Gardner also reports it from Port Townsend, Ludlow Bay, and Channel Rocks near Seattle, Wash.

A plentiful and very well marked plant when fresh, but not always so characteristic in herbarium specimens. No. 343 of Tilden's American Algæ seems to have a broad midrib similar to that of Pleurophycus instead of the usual triple fold, but this may be the result of too much pressure. When young or pressed too much, some plants may readily be taken for forms of *Laminaria solidungula.* So far as we know, the fruit of this species has never been described. No. 5177 shows an extended sorus at the base of the plant, but confined to one surface.

Pleurophycus Gardneri Setchell and Saunders.

On stones in the upper sublitoral zone. Yakutat Bay, Alaska, *Saunders* (1901, p. 427, pl. 52); west coast of Whidbey Island and near Port Townsend, Wash., *N. L. G.*, No. 882!; North Bay, San Juan Island, Wash., *Tilden*, No. 346!

The present very interesting and distinct genus of kelps has been well described by Saunders (loc. cit.) and by Setchell (1901, p. 123), and distributed by Miss Tilden as noted above.

Costaria Turneri Greville.

On rocks in the upper part of the sublitoral zone. Unalaska, Alaska, *Ruprecht* (1852, p. 26, under *C. quadrinervia*); Shumagin Islands, Kukak Bay, Prince William Sound, Yakutat Bay, and Sitka, Alaska, *Saunders* (1901, p. 431); Sitka, Alaska, *Postels and Ruprecht* (1840, p. 12); Puget Sound, *Bailey and Harvey* (1862, p. 160); Victoria, B. C., *Saunders* (1901, p. 431); Esquimalt, B. C., *Harvey* (1862, p. 166), *W.A.S.*, No. 1873!; Port Renfrew, B. C., *Butler and Polley*, No. 8; Whidbey Island and elsewhere throughout Puget Sound, Wash., *N.L.G.*, No. 87!, in Collins, Holden and Setchell, P. B.-A., No. XXXV!; Tracyton, Kitsap County, Wash., *Tilden*, No. 238! (under *C. Mertensii*).

So far as we know, the genus Costaria contains a single species, the differences between *C. Turneri* and *C. Mertensii* being unstable. *C. quadrinervia* Ruprecht is probably to be added, although we searched carefully at Unalaska for such a form without success, and, consequently, must judge from the description alone. It was first collected by Menzies and described by Turner (1819, pl. 226) as *Fucus costatus*. By a curious slip, Turner says on p. 72, "on the western coast of South America," while on p. 73, he says, "Habitat in occidentalibus Americæ Septentrionalis littoribus".

Agarum Turneri Greville.

On rocks in the sublitoral zone, usually found cast ashore. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 43); St. Paul, Alaska, *Ruprecht* (1851, p. 244), *Greeley and Snodgrass*, No. 5794!, (Setchell, 1899, p. 592); Captains Bay, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4088!; Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 12, under *A. pertusum*, p. 11, under *A. Gmelini*); Popof Island, Kukak Bay, Prince William Sound, and Yakutat Bay, Alaska, *Saunders* (1901, pp. 430, 431, under *A. Turneri* and *A. Gmelini*); Unga, Alaska, *A.A.L.*, No. 5057!, *J. B. Downing*, No. 5787!; Harvester Island in Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5111!; Kadiak Island, Alaska, *Postels and Ruprecht* (1840, p. 12, under *A. brassicæforme*); Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5178!; Sitka, Alaska, *Postels and Ruprecht* (1840, p. 12, under *A. platyneuron*).

A considerable study of various forms of Agarum, both on the eastern and western coasts of North America, has led us to the conclusion that the five species or forms enumerated and described by Postels and Ruprecht all belong to one and the same species as indicated above. They all seem to possess a stipe which is cylindrical or nearly so and scrolls at the base of the blade, two characters which distinguish them from the next species.

Agarum fimbriatum Harvey.

On stones or piles, from just below low water mark into water of 10–16 fathoms depth. Esquimalt, B. C., *Harvey* (1862. p. 166); west coast of Whidbey Island, Wash., *N.L.G.*, No. 84!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 678!; Tracyton, Kitsap County, Wash., *Tilden*, No. 345!

This species seems amply distinct from any other Agarum that has been described. It has a very much flattened, rather short stipe which becomes fimbriate with haptere-like outgrowths. The base of the blade has no scrolls as in the preceding species and which we have considered a characteristic of the genus. The margins are peculiarily crispate. It seems to be common in Puget Sound, and has not been found elsewhere, except three specimens which were found cast ashore at San Pedro, California, by Mrs. H. D. Johnston. How it came to be so far south of its hitherto only known district is one of those puzzles of distribution which are extremely difficult to solve.

Thalassiophyllum Clathrus (Gmelin) P. & R.

On rocks, forming a zone at low water mark. Agattu Island, Alaska, *Townsend*, No. 5762!; Kyska Island, Alaska, *Townsend*, No. 5772!; St. Paul Island, Alaska, Herb. *D. C. Eaton*! (Setchell, 1899, p. 592); Amaknak Island, Bay of Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 11), *W.A.S. and A.A.L.*, No. 3246!, and in Collins, Holden and Setchell, P. B.-A., No. XXXVI!; Sitka, Alaska, *Postels and Ruprecht* (1840, p. 11).

This large and striking plant seems to be characteristic of Bering and Ochotsk Seas. The single locality of Sitka, as given by Postels and Ruprecht, exists outside of these, but the locality is doubtful, for Mertens (1829, p. 49) says that he did not see this species until he came to the Bay of Unalaska. It is evidently

a species of the very cold and rough waters. On the Island of Amaknak, it grows in great abundance and was found in all stages of growth. The earliest fronds are ovate and with short stipes. Later they become broadly reniform and begin to roll in at the edges on both sides of the stipe, looking very much like a young *Agarum Turneri* in this stage. The scrolls thus formed become more pronounced, perforations appear, and the central portion of the frond begins to erode and wear away, until finally there are left the much enlarged and thickened, perforated scrolls which wear away on one edge (the inner) and continue to unroll on the other. As they continue to grow, the basal portion of each scroll becomes a sort of stipe and the young plant is plainly dichotomous. As the plant grows on and branches in the irregular manner described by Rosenthal (1890, p. 140, f. 33, 34), this basal dichotomy becomes inconspicuous, and does not seem to have attracted attention before. Its peculiar origin is similar to the process which takes place in Eisenia and in *Hedophyllum subsessile* as mentioned above.

Arthrothamnus bifidus (Gmelin) Ruprecht.

Aleutian Islands, Alaska, *Areschoug* (1884, p. 14).

We know nothing of the occurrence of this species of the Ochotsk Sea and of Bering Island within our territory, farther than the reference quoted above.

Dictyoneuron Californicum Ruprecht.

Port Renfrew, B. C., *Tilden*, No. 519!

Apparently only just reaching the coast of Vancouver Island, certainly not abundant in Puget Sound. This is one of the common species at various localities on the central Californian coast.

Lessonia litoralis Farlow and Setchell.

Port Renfrew, B. C., *Tilden*, No. 342!, *Butler and Polley*, No. 50.

This species was first found on the coast of Oregon by E. Hall, mentioned by Farlow (1875, p. 355), and doubtfully referred to *L. fuscescens*. Later, the same author referred it to *L. nigrescens* (1876, p. 708), but on collecting good material at Monterey, California, he recognized it as new, but only gave it

a manuscript name. The species is common on exposed points in the vicinity of Monterey, where it has been collected by numerous botanists. The name, as given above, was first published and the species was first described by Miss Tilden in her American Algæ (Century IV, 1900). A full description and figures have been given by MacMillan (1900). The blades are of two sorts, the sterile being narrow and with a distinct midrib, while the fertile are broader, plane, and gladiate. On account of this very marked dimorphism, Reinke (1903) has just made it the type of a new genus which he has named Lessoniopsis.

Postelsia palmæformis Ruprecht.

On rocks on exposed points. Strait of Juan de Fuca, B. C., *MacMillan* (1902, p. 213).

This locality marks the most northern limit of this species, which ranges south from this point to Point Sur on the coast of California. It is locally known as the "Sea Palm," and is to be found in small forests or groves, at or near high water mark where the waves are strongest.

Nereocystis Luetkeana (Mertens) P. & R.

On stones, in the sublitoral zone, reaching its full development in 10–12 fathoms of water. Plentiful in the attached condition, from the Shumagin Islands to the region of Santa Barbara Channel on the coast of California. Shumagin Islands, Alaska, *Saunders* (1901, p. 431, under *Nereocystis Priapus*); Uyak Bay, Kadiak Island, Alaska, *W. A. S. and A. A. L.*, No. 5093!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5720!; Esquimalt, B. C., *Harvey* (1862, p. 164); Port Renfrew, B. C., *Butler and Polley*, No. 39; west coast of Whidbey Island, Wash., *N. L. G.*, No. 686!; Port Orchard, Kitsap County, Wash., *Tilden*, No. 237!

The distribution of this species extends from the neighborhood of Point Conception, on the coast of Southern California, to the Shumagin Islands on the coast of Alaska. Beyond this point, it seems very unlikely that the species is to be found attached. It is, however, found cast ashore or floating. It comes ashore sparingly on the shores of the Bay of Unalaska, where one of us found it in the summer of 1899. It is found floating in masses of several acres in extent in the Bering Sea up

to the latitude of the Pribilof Islands. It is reported from the Pribilof Islands by Dall (1875, p. 166), but whether attached or floating is not stated. All along the Alaskan coast below Bering Sea, it is a very common object floating in the water in company with *Alaria fistulosa*, and one is warned of the approach to land by its appearance. It is said by Postels and Ruprecht (1840, p. 9) to be abundant at Sitka, rare at Iliuliuk, Unalaska, and to have been collected on the shores of Kamtschatka by Steller. This last is on the authority of Gmelin (1768, p. 231). Ruprecht, however, states (1852, p. 21) that Steller found the plant near Unalaska or near the Alaskan Peninsula. It has been credited to the Kurile Islands by Captain J. H. Snow (1897, pp. 42, 55, 60, etc.) but the description accompanying the statement shows that the plant observed was *Alaria fistulosa*. The plant has been used for various purposes, by the natives of the Northwest Coast. Ruprecht (1852, p. 21) says that the natives of Sitka place one end of the tube in the ear and the other against a hot stone to generate steam to cure cases of headache. The long solid and slender portion is used for fishlines, and the tube is used as a worm in the process of distilling "Hoochenoo," a dark and poisonous sort of whiskey.

Saunders has resurrected the specific name of Gmelin's *Ulva Priapus* for this species, stating that "Gmelin's figures and description of *Ulva Priapus* leave no doubt as to the identity of his plant." We feel that there is very considerable doubt as to the identity. Gmelin's figure shows nothing characteristic, and while the description is somewhat more explicit, it does not give sufficient data to determine whether Steller's plant is to be referred to Nereocystis or Pelagophycus. The locality whence the specimen came is also in doubt as mentioned above. By a process of exclusion, it may be possible to show strong probability that it is this species and not Pelagophycus, which also floats long distances. The doubt is sufficiently great, however, to prevent us from displacing a name which has been in universal use for over seventy years, even did we believe in choosing names for strict priority.

The histology and development of the species has been given in detail by MacMillan (1899).

Macrocystis pirifera (Turner) Agardh.

On stones, usually in from five to ten fathoms of water. Unalaska and Sitka, Alaska, *Postels and Ruprecht* (1840, p. 9); Sitka, Alaska, *Postels and Ruprecht* (1840, p. 9, under *Lessonia ciliata*), *Ida M. Rodgers*, No. 5727!; Juneau, Sitka, and Wrangell, Alaska, *Saunders* (1901, p. 431); Esquimalt, B. C., *Harvey* (1862, p. 164); Port Renfrew, B. C., *Tilden*, No. 518!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 86!

The long Bladder Kelp is not uncommon on the western coast of North America from somewhere in the neighborhood of Magdalena Bay in Lower California up to the Strait of Juan de Fuca. It does not seem to be plentiful in Puget Sound, itself, or to the north, and it is doubtful as to whether it grows beyond Sitka, Alaska. It may have floated into Unalaska, but it seems certain that it does not grow there, at least on the side of the Bering Sea. The species is found floating to the south of Unalaska in the open ocean. Why the species does not extend farther to the north is certainly a query. It cannot be a matter of too low temperature, since what appears to be the very same plant grows down into the Antarctic waters of much lower temperatures than those of Bering Sea. The sori are supposed to appear only on the bladderless radical leaves, but in specimens from Peru, we have seen sori on leaves near the tip and provided with bladders. Saunders (1901, p. 431) speaks of this species as being confined to the elitoral zone, but we have never seen it growing in over 12 or 15 fathoms of water.

Eisenia arborea Areschoug.

"A broken fragment of this plant was obtained at Wrangell, and several specimens were obtained in Puget Sound," *Saunders* (1901, p. 431).

It certainly seems as if the recording of this plant within our limits must be founded upon an error of determination since the species is not known to grow north of San Pedro, California, and in every way it has the appearance of being a characteristic member of the subtropical region. A plant collected at Whidbey Island was determined by Saunders as being Eisenia, but a careful examination shows it to be *Laminaria Andersonii*.

Egregia Menziesii (Turner) Areschoug.

On rocks, lower litoral and upper sublitoral zones. Nootka Sound, Vancouver Island, B. C., *Menzies* (Turner, 1808, p. 57, pl. 27, under *Fucus Menziesii*); Port Renfrew, B. C., *Butler and Polley*, No. 72; Esquimalt, B. C., *Harvey* (1862, p. 164, under *Phyllospora Menziesii*); Victoria, B. C., *Tilden*, No. 236!; Puget Sound, *Bailey and Harvey* (1862, p. 160); west coast of Whidbey Island, Wash., *N.L.G.*, No. 48!

These localities probably mark the northern limit of this species. Hence it ranges south to the neighborhood of Point Conception, below which its place is taken by *E. lævigata* Setchell.

Pterygophora Californica Ruprecht.

On rocks, upper litoral zone. Port Renfrew, B. C., *Tilden*, No. 520!, *MacMillan* (1902a, p. 726); west coast of Whidbey Island, Wash., *N.L.G.*, No. 70!

This species seems to be abundant on exposed coasts on Puget Sound and reaches a considerable size, as indicated by MacMillan. Specimens fully as large, however, have been collected at Duxbury Reef in Marin County, at Carmel Bay in Monterey County, and at San Pedro in Los Angeles County, California. It seems, therefore, that MacMillan's assumption that Pterygophora reaches its maximum development along the British Columbian coast can hardly be substantiated. As to the relationship of the genus, we cannot hold with MacMillan that it may belong either to the "Laminarieæ or the Alariideæ," but must perforce belong to the latter because of the method of formation of the sporophylls. The possession of rings in the stipe and the hapteres and the fact that the sori do not cover the sporophylls completely, seems to us of little importance in this matter, since in undoubted species of Alaria, there may be rings in the stipe, at east, and in many cases, the sori do not cover the sporophylls completely. In Pterygophora the sporophylls are less determinate in their growth, but this is only of generic importance. We find ourselves in agreement with MacMillan as to the absence of mucilage ducts in the stipe and the presence of large ones in the blade.

Alaria esculenta (L.) Greville.

Arctic Coast of Alaska, *Harvey* (1872, p. 463); from Kamtschatka to Sitka, Alaska, *Postels and Ruprecht*, (1840, p. 11).

The references quoted refer to this species in the old general sense before the majority of the species at present described under the genus had been proposed, or, at least, accepted. In all probability both these references include several, or, at least, other species than *A. esculenta*. We have been inclined to be conservative in reckoning specific distinctions in this genus, but find that we must present a very tentative enumeration. Professor Kjellman has very kindly named a selected series of specimens sent to him and we have used his suggestions and notes, even farther than it is possible to state in each particular case.

Alaria Pylaii (Bory) Greville.

On stones in the lower litoral and upper sublitoral zones. Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5073!; Orca, Alaska, *W.A.S. and A.A.L.*, 5153!; Esquimalt, B. C., *Harvey* (1862, p. 165).

Kjellman is inclined to refer both the Alaskan numbers quoted above, to this species as represented by Greenland specimens and they certainly agree with specimens from Maine which we are disposed to refer to this species. Harvey's specimens are said by Saunders (1901, p. 425) to have been compared by Kjellman to the *A. fragilis* Saunders, which, in turn, seems to us to be little more than a young, long-stiped form of this species.

Alaria dolichorhachis Kjellman.

Agattu Island, Alaska, *Townsend*, No. 5753!

Two specimens, collected at the above mentioned locality, are said by Kjellman, to be near to this species, but still to be separated from it in all probability, while the specimens referred by one of us (Setchell, in Collins, Holden and Setchell, P. B.-A., No. XLI) doubtfully to this species are referred by him to *A. lanceolata* Kjellman.

Alaria tenuifolia Setchell.

Setchell, in Collins, Holden and Setchell, P. B.-A., No. XLV, 1901.

Stipe 16–60 cm. in length, cylindrical or nearly so only at the very base, much flattened above, slender and flexible. Rhachis more or less elongated, flattened, with the sporophylls at first remote, later crowded. Sporophylls from narrowly to broadly lanceolate and cuneate at the base, varying to broadly ovate or oblong and distinctly cordate at the base, with more or less pronounced stipes. Blade elongated, 100–150 cm. long, 10–35 cm. wide, broadly cuneate at the base, very thin, collapsing when withdrawn from the water, with plentiful cryptostomata of small size. Midrib narrow to fairly broad, oblong in cross section.

Not uncommon from Unalaska to Puget Sound.

The description applies to the species, in general, which is better understood if divided into at least two forms, as has been done below. The species is to be distinguished by its very decidedly flattened stipe and thin blade. Specimens from several localities were submitted to Kjellman, who replied that he considered it to be a distinct species belonging either to the group represented by *A. dolichorhachis-oblonga-elliptica* of Kjellman or by *A. membranacea-Pylaii-grandifolia* of J. G. Agardh.

We supposed at first that some, at least, of our specimens might represent forms of *A. grandifola*. This is particularly to be suspected as to the broader forms, while the narrower forms approach *A. Pylaii* and resemble also *A. fragilis* of Saunders. From both of the latter, our plants differ as far as descriptions go, by the flattened stipe.

Alaria tenuifolia f. **typica** Setchell f. nov. PLATE 22.

The type of the species is No. 3286a of Setchell and Lawson's collection on the west shore of Amaknak Island, Bay of Unalaska, Alaska, where the species formed a distinct zone on rocky shores below that of *A. lanceolata* and just above or just below the limits of extreme low water. The stipe is of moderate length, varying from 10 to 15 cm. as a rule, while the blade is comparatively narrow, 8–15 cm. in width, and cuneate at the base. The sporophylls are narrowly to broadly lanceolate with cuneate base and short stalks. The midrib is not noticeably broad.

On rocks and stones at low water mark. Amaknak Island,

Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3286a!, in Collins, Holden and Setchell, P. B.-A., No. XLV!; Juneau, Alaska, *W.A.S. and A.A.L.*, No. 5194!; Douglas, Alaska, *Eldred Jenne*, No. 646!

Alaria tenuifolia f. **amplior** Setchell and Gardner f. nov.

The stipe varies from 10–60 cm. in length, is usually stouter than in the last, and is usually as much flattened. The sporophylls are broad ovate to oblong and cordate, each with a conspicuous stalk. They are frequently very large, measuring 45 cm. in length and 25 cm. in width, with the sorus more or less orbicular and covering only the basal third or fourth. The blade is ample, 20–35 cm. in width and 100–150 cm. long, with the base generally distinctly cordate.

Attached to piles and boulders near low water mark. Esquimalt. B. C., *N.L.G.*, No. 645!, *W.A.S.*, No. 1875!; near Roach Harbor, San Juan Island, Wash., *N.L.G.*, Nos. 650!, 651!

Kjellman seems to think that this is distinct from *A. grandifolia* J. Agardh, of which it seemed to us to be possibly a smaller form.

Alaria crispa Kjellman.

Upper sublitoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 37).

Known to us only from Kjellman's description and figures.

Alaria prælonga Kjellman.

On rocks, lower litoral zone. St. Paul Island, Alaska, *Townsend*, No. 5781!, (Setchell, 1899, p. 592); Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5130!

The first number (5781) is referred to this species by us and seems to be fairly typical, judging from specimens and plate. No. 5130 is said by Kjellman to belong to the same group of species, but differs from typical *A. prælonga* in the shape of the blade which is more abruptly attenuated toward the base and is broader than in the type. This species continues down to the Californian coast, where it appears in several forms. *A. curtipes* Saunders (1901a, p. 561, pl. 33) seems to us to belong to the form-cycle of this species.

Alaria laticosta Kjellman.

In the sublitoral zone in protected coves. Kukak Bay, Alaska, *Saunders* (1901, p. 425).

Saunders says that "Kjellman referred the plants sent him to this species with considerable doubt." Quoting Kjellman, he says:—"The form, color, and consistency of the blade, and the form, width and rigidity of the sporophyll differ somewhat from this species."

Alaria lanceolata Kjellman.

On rocks in the litoral and sublitoral zones. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3249!, in Collins, Holden and Setchell, P. B.-A., No. XLI!; Glacier Bay and Sitka, Alaska, *Saunders* (1901, p. 426).

This species is, according to a report from Kjellman, the *A. dolichorhachis?*, distributed as No. XLI of the P. B.-A., but he adds that the blade is not so dark as in his specimens. We find, however, that in some of the specimens of that collection the blade is much darker than in the one sent for his inspection.

Alaria marginata P. & R.

Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 11).

Besides the reference above, Harvey (1862, p. 165) has credited this species doubtfully to Esquimalt, B. C. Ruprecht (1851, p. 355) says that the species is rare and had occurred to him lately only from Fort Ross on the Californian coast. It is evidently a species with a broad solid midrib, a short cylindrical stipe, long and rather narrow sporophylls, and in most ways, as far as the incomplete description goes, resembling the *A. laticosta* of Kjellman.

Alaria fistulosa P. & R.

Gregarious, on rocks and stones, in the sublitoral zone. From the Kurile Islands and Northern Japan to the southeastern boundary of Alaska. For the species in general the following localities are recorded in our territory:—Unalaska Bay and Kadiak Island, Alaska, *Postels and Ruprecht* (1840, p. 11); Kukak Bay, Cook Inlet, Prince William Sound, Yakutat Bay, Glacier Bay, Juneau, and Wrangell, Alaska, *Saunders* (1901, p. 426).

This species takes the place of *Macrocystis* along the northern shores of our territory, in forming beds of kelp off rocky shores in waters of several fathoms depth. Its fronds are anchored and the stipe, bunch of sporophylls and much of the blade is submerged, but the long blade, reaching a length of 10–25 meters, rises to the surface and, buoyed up by the inflated midrib, generally floats for some distance on the top of the water. The plants are gregarious, and often form belts a longer or shorter distance from the shore as the Macrocystis does farther south. Like the Macrocystis and the Nereocystis, it is commonly met with floating and often in considerable quantity. While passing through Unimak Pass, between Bering Sea and the Pacific Ocean, the surface of the broad expanse of waters is commonly seen to be thickly covered with the floating blades of this species, and it was observed in fair abundance all along the coast of Alaska from the latitude of the Pribilof Islands in the Bering Sea to Wrangell Narrows in southeastern Alaska. It was carefully watched for to the south of the last mentioned locality, but no trace of it was seen. The species varies much, particularly in the width of the blade and shape of the sporophylls. As these plants are of different habitats, it has seemed best to enumerate the specimens actually examined and observed growing, under the forms described below. The stipe of this species seems to be free from mucilage ducts, but the blade in both forms possesses abundant structures of this kind, just under the outer layer of cells as Guignard has indicated (1892, p. 43).

Alaria fistulosa f. stenophylla Setchell.

Blade narrow, usually not over 30 cm., with narrow midrib. Sporophylls usually short and more or less decidedly obovate.

Forming the greater portion of the growth in belts just off shore and isolated bunches in quiet waters of 5 to 10 fathoms. Kyska Island, Alaska, *Townsend*, No. 5769!; plentiful in the Bay of Unalaska, both on the shores of the Island of Unalaska and the shores of the Island of Amaknak, Alaska, *W.A.S., A.A.L., and L. E. Hunt*, Nos. 3273!, 4096!, and in Collins, Holden, and Setchell, P. B.-A., No. XLIII!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No.

5117!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5102!; Douglas, Alaska, *Eldred Jenne* No. 647!

The specimens noted above were all found growing attached except possibly (and probably) the last. The form is found floating along the whole extent of Alaskan coast from near Wrangell to the Pribilof Islands. It is the form commonly observed. Young specimens of this form, collected at Unalaska, show that the fistulose character of the midrib, appears very early in the course of development, since specimens with blades 15 cm., or less long, show it well developed.

Alaria fistulosa f. platyphylla Setchell.

Blade broad, usually 60–90 cm. broad, midrib very much inflated and broad. The sporophylls are numerous, often as many as 90 or 100 on each side of the rhachis, are long and narrow, generally being linear-lanceolate in shape, 30–50 cm. long and 3–6 cm. wide.

Growing in deep water, usually found floating or cast ashore. Deeper parts of the Bay of Unalaska, Unalaska, Alaska, *W.A.S., A.A.L., and L. E. Hunt*, No. XLII in Collins, Holden and Setchell, P. B.-A!; seen floating in a number of localities in the Gulf of Alaska.

The present form seems to be an inhabitant of deep waters and is usually found floating or cast ashore. A single complete specimen cast ashore at Iliuliuk, Unalaska, Alaska, was found to measure somewhat over 25 meters in length, over 1 meter in width, with a large bunch of long sporophylls numbering about 200.

Alaria cordata Tilden.

Attached to rocks, lower litoral and upper sublitoral zones. Yakutat Bay, Alaska, *Saunders* (1901, p. 426); Port Renfrew, B. C., *Tilden*, No. 241b!; San Juan Island, Wash., *Tilden*, No. 241a!

The species noted above is known to us from a young specimen (Tilden, No. 241a), a couple of sporophylls (Tilden, No 241b) and the figure of Saunders (1901, pl. 56). There seems to be no character to separate it from *A. Pyallii*.

Alaria fragilis Saunders.

In the sublitoral zone. Kukak Bay, Prince William Sound, and Glacier Bay, Alaska, *Saunders* (1901, p. 425).

It certainly seems to us that this plant is likely to prove to be nothing more than a variety of *A. Pylaii* with a somewhat elongated stalk, such as certainly does occur among plants of that species. The distant sporophylls as well as their shape is due to the youth of the plant.

Alaria fragilis f. bullata Saunders.

With the last. Glacier Bay, Alaska, *Saunders* (1901, p. 425).

Apparently only a state of the last.

Alaria valida Kjellman and Setchell sp. nov. PLATE 21.

Stipe short, 1–5 cm. long, cylindrical, at first slender, but at length stout and showing rings of growth, reaching a diameter of 13 mm., showing also a well developed cork layer. Rhachis at first short, becoming very much elongated, up to 15–20 cm., somewhat flattened, obtuse on the edges, stout like the stipe. Sporophylls linear lanceolate, 15–50 cm. long and 3–6 cm. wide, with margins undulate and all except the narrow margins and a small portion of the tip occupied by the sorus. Blade long, up to 3–4 meters, 15–25 cm. wide, tapering very gradually to the base, with broad midrib (22 mm. wide) which is little prominent and abruptly narrowing towards each end in cross section.

This belongs to the group of species with broad midribs and is fairly nearly related to *A. laticosta* Kjellman, but differs from that species chiefly in the stouter stipe and rhachis and the longer and broader sporophylls. Its relation to *A. marginata* P. & R. is still to be settled.

In the sublitoral zone. Unga, Alaska, *A.A.L.*, No. 5059!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 111!

Specimens of the above collections were sent to Professor Kjellman, who recognized them as belonging to a new species. We have drawn up the description and given the name to the plant on account of the broad stipe and rhachis. In the type, the stipe is short, but in the following form it is much longer.

Alaria valida f. **longipes** Setchell and Gardner f. nov.

Stipe long, 8–20 cm. in length, not including any of the rhachis. Otherwise as in the type.

With the typical form on the west coast of Whidbey Island, Wash., *N.L.G.*, No. 111!

A few specimens from the west coast of Whidbey Island, growing on the same rocks with the typical form, show such pronouncedly longer stipes from the majority of the specimens that it seems necessary to call attention to them under a separate form name.

Family DICTYOTACEÆ.

Dilophus flabellatus Collins.

Washed ashore. Sackman's Point, near Tracyton, Kitsap County, Wash., *Tilden*, No. 335!, under *Dictyota dichotoma* f. *latifolia*.

This has been compared with the plant of Collins (in Collins, Holden and Setchell, P. B.-A., No. 834, 1901) both by Collins, and ourselves. It seems to certainly be the same. It, as well as the cotype cited, does not show the Dilophus-structure in all parts and it may be doubted as to whether Dilophus is really distinct from Dictyota and also as to whether *D. flabellatus* is really distinct from *Dictyota Binghamiæ* of J. G. Agardh. It seems distinct, but farther study and comparison is needed. However, it is a strange matter of distribution to find a plant, hitherto known only from Southern California and distinctly subtropical, in this northern locality. It may be that there will be found other warm water species in the inland and shallower portions of Puget Sound. Miss Tilden has kindly informed me that, in her opinion, this plant must have grown near the place where it was found, "for it came up in large quantities and at all times on the incoming tide". The only other collection of this species, north of Santa Barbara, California, known to us, was made by one of us at Monterey, California, near the steamboat wharf, shortly after the arrival of a steamer from Southern California.

FAMILY FUCACEÆ.

Fucus inflatus (L.) Vahl.

The present species has been the subject of considerable research on the part of the Scandinavian Algologists and the latest study is contained in the very recently issued work of Börgesen (1902, pp. 465–472). The account of Börgesen seems to the writers to deal most satisfactorily with the forms of the west coast of North America usually included under the name of *Fucus furcatus* Agardh and will consequently be followed by us. The form usually classified under Agardh's name does not agree with the type figure (Agardh, 1821, pl. 14), which is a smaller and less perfectly developed plant, as Börgesen has pointed out (loc. cit., p. 465), and a transitional form between two distinct forms.

Fucus inflatus f. edentatus (De la Pylaie) Rosenvinge.

Attached to rocks at low water mark. Victoria, B. C., *Tilden*, No. 234, under *F. furcatus*!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 91!

No. 91 is a large broad typical plant, agreeing well in every character with the *F. edentatus* of the New England coast. No. 234 is still typical but not quite so well developed. The type of *F. furcatus* seems to represent a dwarfed and not symmetrically developed form and is said by Agardh to have been collected at Unalaska by Chamisso. One of us has searched very carefully in the region of the Bay of Unalaska for it, but has failed to find any trace of it, and Ruprecht (1851, p. 346) says that the original specimen came, not from Unalaska, but from Fort Ross in California where it is common. Kuetzing's figure (1860, pl. 17, II), which is seemingly from the original material of *F. furcatus*, although small, is typical of the *edentatus* form. Harvey (1862, p. 163) refers specimens from Esquimalt doubtfully to *F. furcatus*.

Fucus inflatus f. linearis (Œder) Rosenvinge.

Fairhaven, Wash., *N.L.G.*, No. 189!

To this form, we have referred some specimens which agree fairly well with the preceding form, but are much narrower. The plants are about 15 cm. high and 3 mm. wide, while the

plants of the preceding form which represent the typical form, are 30–45 cm. high and 6–10 mm wide. The narrowness of the frond and the acute angles between the fairly regularly dichotomous branches give it a very distinct appearance. It represents a distinct transition from the preceding to the following.

Fucus inflatus f. **filiformis** (Gmelin) Setchell and Gardner f. nov.

This seems to be the *F. filiformis* of Gmelin, or at least what has passed under that name on the coast of New England. The plants are 8–10 cm., even at times 15 cm., high and seldom over 1–2 mm. wide. While the midrib is distinct in some plants or in some parts of others, as a rule the main portion of the frond is reduced to the thickened midrib portion itself without alæ. The receptacles are fairly broad in proportion to the sterile portion of the frond.

On sand rocks, uppermost litoral zone. Fairhaven, Wash., *N.L.G.*!

An extreme form as regards the slender character of the frond, and it also has a tendency to spread out and become more flabellate in its dichotomy. Somewhere under *F. inflatus* is probably to be referred the *F. Miclonensis* mentioned by J. G. Agardh (1870a, p. 35) as occurring at Vancouver Island, B. C.

Fucus evanescens Agardh.

The type of the present species came from Kamtschatka and the species itself is well developed in the region of the North Pacific as well as in the North Atlantic. As a rule it is easily recognized in its broader forms, by its habit, and by the midrib vanishing below the tips of the branches. It approaches in some of its forms to *F. platycarpus* Thuret, and one of us has been inclined to refer some forms which had some indication of a more pinnate method of branching to the latter species. It seems best, however, to refer all the plants not distinctly belonging to the preceding species to *F. evanescens*. It is interesting to note that Börgesen (1902, p. 472) refers Thuret's species to *F. spiralis* L.

Fucus evanescens f. typica Kjellman.

On rocks, upper litoral zone. Harvester Island, Uyak Bay Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5122!

The specimens referred here are the only ones we have seen from our territory, which agree thoroughly with the plate of Agardh (1821, pl. 13).

Fucus evanescens f. limitatus Kjellman.

In the sublitoral zone. Port Clarence, Alaska, *Kjellman* (1889, p. 34); Besboro Island, Norton Sound, Alaska, *R. C. McGregor*, No. 5683!

We refer the plant from Besboro Island to this form with some considerable doubt, since there is only the description to guide us. In general shape and size of the frond, and shape of the receptacles, it seems to agree better than with any other form so far described.

Fucus evanescens f. rudis Kjellman.

On rocks in the sublitoral zone. Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5121!

As we understand this form, it differs from f. *typica* by its narrower, more linear frond, and more pointed receptacles. It grew near the plants referred to the typical form, but in a distinct patch, with a somewhat different aspect.

Fucus evanescens f. macrocephalus Kjellman.

On stones, upper litoral zone, in quiet waters. Cape Dyer, Alaska, *Newhall and Rhodes*, Nos. 5791!, 5792!; east shore of Amaknak Island, Bay of Unalaska, Alaska, *R. C. McGregor*, No. 5689!, *W. A. S. and A. A. L.*, No. 4077!; Shumagin Islands, Kukak Bay, Cook Inlet, Prince William Sound, and Glacier Bay, Alaska, *Saunders* (1901, p. 432); Skaguay, Alaska, *A. L. Bolton*! (young); Sitka, Juneau, Wrangell, and Annette Island, Alaska, *Saunders* (1901, p. 432); Whidbey Island, Wash., *N. L. G.*, No. 89!; Tracyton, Kitsap County, Wash., *Tilden*, No. 235!

Some of the specimens quoted above are referred here with doubt, but the greater part of them agree well with Kjellman's description and with the plate of Saunders (1901, pl. 72, f. 1).

Fucus evanescens f. **robustus** Setchell and Gardner f. nov.

Caulescent with the stipe stout and erect, 15–18 cm. high, broad above, 2–2.5 cm. wide, midrib narrow and distinct to just below the apices, with broad oblong ovate or obcordate, short, flat, margined receptacles.

St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5805! (cf. Setchell, 1899, p. 593, under *F. platycarpus?*); Sitka, Alaska, *Ida M. Rodgers*, No. 5724!

The type is No. 5724, from Sitka. The form resembles the last, but is more robustly caulescent, the foliaceous portion is thicker, while the receptacles resemble those of typical *F. platycarpus* Thuret, from which it is to be distinguished by its lack of strongly pronounced pinnate habit. From f. *dendroides*, which it resembles in its arborescent habit, it is to be distinguished by the broader foliaceous frond and the broader receptacles.

Fucus evanescens f. **cornutus** Kjellman.

On rocks in exposed places, lower portion of the litoral zone. Popof Island, Kukak Bay, Prince William Sound, Yakutat Bay, and Juneau, Alaska, *Saunders* (1901, p. 432); Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5719!; Esquimalt, B. C., *N.L.G.*, No. 625!, in Collins, Holden and Setchell, P. B.-A., No. 927!

To be distinguished by its forked, often swollen receptacles whose branches are pointed and horn-shaped. The form varies somewhat. No. 5719 is a very large plant, 30 cm. high and rather broad winged in the upper part for this form.

Fucus evanescens f. **longifructus** Setchell and Gardner f. nov.

Somewhat caulescent below, foliaceous above, up to 45 cm. high and 1–2 cm. wide, midrib not pronounced. Receptacles of various shapes from short, broad, blunt, and broadly obcordate to elongated and once or twice forked, with the divisions long, curved and pointed. These elongated receptacles give the characters of the form and reach a length of 15–18 cm.

On stones, upper and middle litoral zones in waters much mixed with glacial waters. Orca, Alaska, *W.A.S. and A.A.L.*, No. 5151!, in Collins, Holden and Setchell, P. B.-A., No. 928!; Juneau, Alaska, *W.A.S. and A.A.L.*, No. 5186!

Probably a state or form produced by the admixture of cold milky waters from the glaciers, and possessing characters intermediate between ff. *macrocephalus* and *rudis*, but those of the latter much exaggerated. The receptacles seem to continue growing at the tips after they have become more or less disassociated from the rest of the plant at their bases. In the Juneau specimens the receptacles are decidedly swollen.

Fucus evanescens f. contractus Kjellman.

On rocks in the litoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 34); Golofnin Bay, Alaska, *R. C. McGregor*, Nos. 5673!, 5679!; St. Michael, Alaska, *W.A.S.*, Nos. 5238!, 5239!, 5252!

A narrow plant referred, as to other than Kjellman's plants, with some doubt.

Fucus evanescens f. dendroides Stroemfelt.

Agattu Island, Alaska, *Townsend*, Nos. 5755!, 5756!

The specimens referred here seem to agree well with Stroemfelt's description and figure (1886, p. 35, pl. 3). It is certainly a form of decidedly arborescent appearance, presumably erect in habit.

Fucus evanescens f. pergrandis Kjellman.

On stones near high water mark. Kyska Island, Alaska, *Townsend*, No. 5773!; east shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3284!, 4049!, in Collins, Holden and Setchell, P. B.-A., No. XLVI!, under *F. platycarpus*; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5701!; Port Renfrew, B. C., *Butler and Polley*, No. 20!

A large, broad form with large, broad receptacles which are sometimes very flat or sometimes very considerably swollen.

Fucus evanescens f. angustus Kjellman.

On rocks in the lower litoral zone. Whidbey Island, Wash., *N.L.G.*, No. 76!; East Sound, Orcas Island, *N.L.G.*, No. 624!, in Collins, Holden and Setchell, P. B.-A., No. 926!

A narrow form to be compared with *f. contractus*, from which it seems to differ in aspect on account of its more regularly branched, linear frond.

Fucus evanescens f. nanus Kjellman?

Yakutat Bay, Alaska, ***Rev. Albin Johnson***, No. 5712! (sterile).

A dwarf, slender, irregularly branched form, referred here doubtfully on account of its sterile condition.

Fucus evanescens f. bursiger (J. Agardh) Kjellman.

On rocks at extreme upper tide limit. Summer Bay, Unalaska, Alaska, *W. A. S. and A. A. L.*, No. 4052!; Dutch Harbor, Unalaska, Alaska, *R. C. McGregor*, No. 5689a!; Whidbey Island, Wash., *N. L. G.*, No. 90!

A depauperate form of the uppermost portion of the litoral zone, agreeing with the description and figure of J. G. Agardh (1870a, p. 35, pl. 3).

Under *Fucus evanescens* are probably to be placed the older references to the occurence of *F. vesiculosus*, a species lacking, in all probability, on our western coast. Most of the references state that the species is represented by the form without vesicles. The following are to be noted:

F. vesiculosus Postels and Ruprecht (1840, p. 12). Sitka, Alaska.

F. vesiculosus var. *minor* Harvey (1841, p. 134). Kotzebue Sound, Alaska.

F. vesiculosus Bailey and Harvey (1862, p. 160). Puget Sound.

F. vesiculosus var. *evesiculosus* Harvey (1862, p. 163). Esquimalt and Victoria, B. C.

F. vesiculosus Harvey (1872, p. 463). Kotzebue Sound, Alaska.

Family SARGASSACEÆ.

Cystophyllum geminatum (Agardh) J. Agardh.

On rocks, in sheltered places, lower litoral and upper sublitoral zones. Bay of Morozof (Morzhovoi Bay), Alaska, *Townsend*, No. 5778!; Shumagin Islands and Kukak Bay, Alaska, *Saunders* (1901, p. 432, under *C. Lepidium*); Kadiak Island, Alaska, *Ruprecht* (1851, p. 348, under *Cystoseira thyrsigera*); Yakutat Bay, Sitka, and Wrangell, Alaska, *Saunders* (1901, p.

432, under *C. Lepidium*); Banks Island, B. C., *Harvey* (1857, p. 122); Victoria, B. C., *Saunders* (1901, p. 432, under *C. Lepidium*); in 14 fathoms, Esquimalt, B. C., *Harvey* (1862, p. 163); Port Renfrew, B. C., *Butler and Polley*, Nos. 19, 103; west coast of Whidbey Island, Wash., *N. L. G.*, No. 36!, in Collins, Holden and Setchell, P. B.-A., No. XLVII!, under *C. Lepidium*; Friday Harbor, San Juan Island, Wash., *Tilden*, No. 232!, under *C. Lepidium*.

Five species are quoted from the coasts ranging between the Ochotsk Sea and Puget Sound, viz., *Cystoseira geminatum* Agardh, *C. thyrsigera* P. & R., *C spicigera* Mertens and Agardh, *C. Lepidium* Ruprecht, and *C. hypocarpa* Kuetzing. It is questionable whether there are characters to separate them from one another and it has seemed necessary to place them all under one name for the present. *C. spicigera*, however, is said by Ruprecht (1851, p. 348) not to represent without emendation, any certainly known species, and consequently, although this name is the oldest, it seems best not to adopt it because of the uncertainty. From the descriptions and figures it certainly seems that *C. thyrsigera*, *C. Lepidium*, and *C. hypocarpa*, refer at least, to forms of the same species and are to be united. The identity of *C. thyrsigera* and *C. geminatum* rests on the authority of J. G. Agardh.

Cystoseira osmundacea (Menzies) Agardh.

Sannak Island, Alaska, *Turner* (1886, p. 85).

This is the only reference to this common Californian species as occurring within our limits. It is to be questioned as to whether it may not be the preceding species masquerading under this name.

RHODOPHYCEÆ.

The Rhodophyceæ of the Northwest Coast are more numerous than had been supposed until within a few years, and form a group which has taxed our efforts to the utmost. The abundant materials collected in our hands has presented to us a large number of problems of identification which we trust we have

either solved, or at least, have not left in such a condition as to confuse others. We have preferred here, as in the foregoing groups, to deal with what seem to be polymorphous species in many cases, and have adopted the method of naming forms to give definiteness to our ideas of the amplitude of variation. Our studies on the Californian Coast have helped us much in realizing the extreme variation which a species of algæ may undergo under circumstances of varying environmental conditions and still adhere to the general type. We have followed in general arrangement and largely in the selection of the generic names and generic distinctions, the work of Schmitz and his collaborators, Hauptfleisch and Falkenberg (1896–1897) in Engler and Prantl. In some cases, we have departed and have followed J. G. Agardh in his later arrangements of the genera formerly grouped under Delesseria and Callithamnion, and for good reason as it has appeared to us. We have also found much help on many groups from Kjellman's critical notes in the Algæ of the Arctic Sea (1883). For unravelling the difficulties in some genera, Ruprecht (1851) has been indispensable and Kuetzing's Tabulæ Phycologicæ have assisted greatly. In this group, particularly, which has been less thoroughly studied, it has been necessary to examine all the literature available in almost every case. We have derived very considerable information from Yendo's papers on Corallinæ Veræ (1902 and 1902a), although we cannot agree with him in the closeness of his specific distinctions.

We are indebted to M. Foslie of Trondheim, Norway, for the account of the crustaceous Corallinaceæ, and to Mr. F. S. Collins, and through him to Professor W. G. Farlow, for help in many cases of troublesome synonymy. To Mr. H. T. A. Hus, we are desirous of expressing our thanks for examining all of the material of the genus Porphyra and for the masterly way in which he has unravelled the difficulties of specific distinction in that genus.

As regards comparative distribution of the species of this large group, we are, as yet, hardly in a position to make any very general or explicit statements. A very considerable number of the species found in the North Temperate Region of the Pacific Coast of North America are continued into Puget Sound, and

even up to Sitka or Yakutat Bay, or farther on. There are, however, to be found in the vicinity of Puget Sound, many species characteristic of the Boreal Region which are not to be found farther to the south. Many more species of the North Atlantic are to be found in our territory than farther south along the coast, and, as we proceed northward, these species and those closely related to them form the characteristic portion of the flora. In the Upper Boreal, the North Atlantic and Arctic character is very pronounced, intermingled with some species characteristic of the Lower Boreal. Very little, however, is known, as yet, of the species of this region.

FAMILY BANGIACEÆ.

Bangia atropurpurea f. fuscopurpurea (Dillwyn) J. Agardh.

On old wood of piles, floats, and wharves, in the litoral zone. Dutch Harbor, Amaknak Island, Bay of Unalaska, Alaska, *R. C. McGregor*, No. 5691!; Juneau, Alaska, *W.A.S. and A.A.L.*, No. 5199!; Victoria, B. C., *Saunders* (1901, p. 432, under *B. atropurpurea Pacifica*); Port Renfrew, B. C., *Tilden*, No. 333!, under *B. vermicularis*, *Butler and Polley*, No. 111; west coast of Whidbey Island, Wash., *N.L.G.*, No. 125!; Orcas Island, Wash., *N.L.G.*, No. 684!; Seattle, Wash., *N.L.G.*, Nos. 306!, 306a!; Pleasant Beach, Kitsap, County, Wash.. *N.L.G.*, No. 350!

This seems to be the only species yet collected within the limits of our territory, although we have kept careful watch for the *B. vermicularis* of the Californian coast. As yet no species has appeared which compares with that in coarseness of filament. The specimen distributed by Miss Tilden under *B. vermicularis* is slender even for f. *fuscopurpurea*. It seems to us somewhat doubtful, however, whether *B. vermicularis* is, itself, distinct from this species. J. G. Agardh (1882, p. 37) seems to have been inclined to separate the Californian form of *B. atropurpurea* as distinct, but evidently decided not to give it a different name, although the plate (loc. cit., pl. 1, f. 34–39) has the legend, *B. Pacifica*, while the explanation of the figures (loc. cit., p. 179) has the trinomial *B. atropur-*

purea Pacifica. We hardly think that Agardh intended to use either as a name for the Californian plant, but Saunders (1901' p. 432), however, has used the latter to designate a plant from Victoria, B. C., and without explanation.

Porphyra laciniata (Lightfoot) Agardh.

On rocks or on *Fucus evanescens* in the litoral zone, or even in the upper sublitoral zone. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3269!, 3270!; Orca, Alaska, *W.A.S. and A.A L.*, No. 5164!; Yakutat Bay, Alaska, *Saunders* (1901, p. 433), *Rev. Albin Johnson*, No. 14!; Sitka, Alaska, *Saunders*, No. 136!; Annette Island, Alaska, *Saunders*, No. 26!

So far as the data are accessible to us, the present species seems to be confined to the coasts of Alaska. In this, as in the following species, we have followed the account of Hus (1902) in the citation and distribution. *P. laciniata* is cooked by the Indians of Yakutat Bay and eaten. This is reported to us by Rev. Albin Johnson, and we have observed Yakutat Indians at Orca drying it, evidently for a food supply.

Porphyra laciniata f. **umbilicalis** Agardh.

St. Paul Island, Alaska, *Townsend*, No. 5780! (Setchell, 1889, p. 593).

Differs from the preceding chiefly in its well marked umbilicate base.

Porphyra perforata J. Agardh.

On rocks in the litoral and upper sublitoral zones. Shumagin Islands, Alaska, *Saunders*, No. 394!; Glacier Bay, Alaska, *Saunders*, No. 100!; Sitka, Alaska, *Saunders*, No. 130!; Victoria, B. C., *N.L.G.*, No. 318!; Esquimalt, B. C., *N.L.G.*, No. 322!; Port Renfrew, B. C., *Butler and Polley*, No. 45; west coast of Whidbey Island, Wash., *N.L.G.*, No. 97!; Orcas Island, Wash., *N.L.G.*, No. 295!; San Juan Island, Wash., *N.L.G.*, No. 286!

A very common species in the region of Puget Sound, but less so on the coast to the north. The species has been well defined and described by Hus (1902). As a rule the typical form is a

fairly large plant, but No. 322 is nearly 4 meters long and 1.5–2 meters wide, one of the largest of known Porphyras.

To this species are probably to be referred the plants mentioned under *P. vulgaris*, as follows: Esquimalt, B. C., *Harvey* (1862, p. 176) and Puget Sound, *Bailey and Harvey* (1862, p. 163).

Porphyra perforata f. segregata Setchell and Hus.

On rocks. West coast of Whidbey Island, Wash., *N.L.G.*, No. 66!; Seattle, Wash., *Tilden*, No. 228!, under *P. leucosticta*.

This is a dwarf form, with thickened cell walls and the upper and lower halves of the contents of the antheridia separated by a thick gelatinous wall.

Porphyra Nereocystis C. L. Anderson.

On *Nereocystis Luetkeana*. Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5112!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5149!; Whidbey Island, Wash., *N.L.G.*!

This species may be known from forms of the preceding species by its red color, usually thinner frond, and by the arrangement of the sporocarps and antheridia which do not form the narrow elongated more or less linear patches of *P. perforata*.

Porphyra naiadum f. minor Hus.

On leaves of Phyllospadix. Port Renfrew, B. C., *Tilden*, No. 516!, *Butler and Polley*, No. 47.

Porphyra naiadum f. major Hus.

On the leaves of Zostera. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 182!, 183!, 273!; Brown Island, San Juan County, Wash., *Tilden*, No. 231b!; Seattle, Wash., *Tilden*, No. 231a! (a very poor specimen.)

P. naiadum is a very distinct species on account of the cushion-shaped parenchymatous prothallus, as has been shown by Hus (1902).

Porphyra amplissima (Kjellman) Setchell and Hus.

On rocks, upper sublitoral zone. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3268!; Unga,

Alaska, *A.A.L.*, No. 5047!; Orca, Alaska, *W.A.S. and A.A.L.*, No. 5165!, *Saunders*, No. 259a! and 1901, p. 433, cited as from "Prince William Sound"; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 47!, 199b!, 280!, 688!, and in Collins, Holden and Setchell, P. B.-A., No. XLIX!

P. amplissima is very variable as to size, habit and tint of red, but it is always distromatic and has the antherozoids in four tiers of four each in the antheridium, as Kjellman has figured them (1883, pl. 18, f. 8).

Porphyra miniata f. cuneiformis Setchell and Hus.

On rocks, on wood, and on other algæ. Lowe Inlet, Alaska, *Saunders*, No. 20!; Victoria, B. C., *Tilden*, No. 230!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 199a!, in Collins, Holden and Setchell, P. B.-A., No. 929!; Pleasant Beach, Kitsap County, Wash., *N.L.G.*, No. 348!

This species is to be distinguished from the two following very nearly related species, by its habit or color, being decidedly darker red and rather thicker than the next, and larger and more completely distromatic than *P. abyssicola*.

Porphyra tenuissima (Stroemfelt) Setchell and Hus.

On rocks and other algæ. Shumagin Islands, Alaska, *Saunders*, No. 384!; Yakutat Bay, Alaska, *Saunders*, No. 214!, *Rev. Albin Johnson*, No. 5705!

Readily recognized, as a rule, by its thin, light red or pink, distromatic frond.

Porphyra abyssicola Kjellman.

On Zostera. West coast of Whidbey Island, Wash. *N.L.G.*, 273a!

As stated above, this species is not very distinct from *P. miniata* f. *cuneiformis*, differing from that plant in its smaller size and less distinctly or less completely distromatic frond.

Porphyra variegata Kjellman.

Found floating up from the sublitoral zone where it grows on rocks. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 177!, 179!, 279!, 687!, and in Collins, Holden and Setchell, P. B.-A., No. 930!

The type is *Diploderma variegatum* Kjellman (1889, p. 33, pl. 2, f. 1–4) from Bering Island, Siberia. The species is readily recognized by its thick and variegated frond. To this species must be joined *P. occidentalis* Setchell and Hus (Hus, 1900, p. 69 and 1902, p. 228, pl. 21, f. 15a–17b), since farther search on the coast of California has brought other more luxuriant, thicker specimens to light and it has been made certain that it is the antheridial plant of *P. variegata*.

Erythrotrichia ceramicola (Lyngbye) Areschoug.

On *Lophosiphonia villum*. St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5148a!

FAMILY HELMINTHOCLADIACEÆ.

Batrachospermum monilforme Roth.

Chilukweynk Valley, Vancouver, Island, B. C., *Harvey* (1862, p. 176).

We know this only from the reference and consequently do not know whether it is *B. moniliforme* in the sense of Sirodot or not. The species of this genus have not been sufficiently studied as yet, but we shall attempt to refer ours to the species of Sirodot's monograph, at least provisionally.

Batrachospermum moniliforme f. typicum Sirodot.

In fresh water streams. Baird Creek, Port Renfrew, B. C., *Tilden*, No. 332!, under *B. moniliforme* var. *Scopula*; Port Renfrew, B. C., *Butler and Polley* and in Collins, Holden and Setchell, P. B.-A., No. 876!

The two collections quoted above seem to be typical of this species as we understand it. The cystocarps are of uniform size, not large, and situated in the outer half of the verticil but well included.

Batrachospermum moniliforme f. helminthoideum Sirodot.

In a creek. Orcas Island, Wash., *N.L.G.*, No. 702.!

We have some doubt of the determination of this plant, but it seems to agree with the description of Sirodot. It differs from

the last in having the interverticillary filaments developed to such an extent as to obscure the moniliform habit.

Batrachospermum pyramidale Sirodot.

Attached to boards and stones in a rapidly running stream of fresh water. Newhall, Orcas Island, Wash., *N.L.G.*, No. 616!

The verticils are usually globular, distant, and distinct, while the cystocarps vary in size and distance from the center of the verticil, all, however, being included within it.

Batrachospermum densum Sirodot.

On stones in a small rill of fresh water. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3298!

The verticils are discoid and confluent below on account of the growth of the interverticillary filaments. The whole plant is dark purplish green. The cystocarps are small with relatively large spores included within the inner half of the verticil.

Batrachospermum ectocarpum Sirodot.

Attached to stones in running fresh water. Near Dexter, Golofnin Bay, Alaska, *R. C. McGregor*, No. 5664!; Chambers Creek, near Tacoma, Wash., *N.L.G.*, No. 427!

Distinguished by the large cystocarps which are at the outer edge of the verticil, often more or less exserted, but without conspicuous bracteoid filaments.

Batrachospermum vagum f. flagelliforme Sirodot.

In ponds, pools, and streams of fresh water.

Kadiak Island, Cook Inlet, and Virgin Bay in Prince William Sound, Alaska, *Saunders* (1901, p. 433).

Batrachospermum vagum f. keratophytum Sirodot.

In a stream of fresh water. Near Port Renfrew, B. C., *Tilden*, No. 515!, *Butler and Polley*, in Collins, Holden and Setchell, P. B.-A., No. 879a!

Batrachospermum cœrulescens Sirodot.

Nooksack River, Whatcom County. Wash., *N.L.G.*, No. 701!

The material is preserved in formalin, so that the color is no longer apparent, but the plant, when fresh, was decidedly blue, and

is certainly of the *Viridia*-group, diœcious and at least very near to this species as understood by one of us in Collins, Holden and Setchell, P. B.-A., Fasc. IV, No. 190, 1896.

Chantransia secundata Lyngbye.

On hydroids. San Juan Island, Wash., *Tilden*, No. 308!, under *Callithamnion secundatum*.

The specimen in our copy is sterile and looks more like *Ch. Daviesii* (Dillwyn) Thuret.

FAMILY CHÆTANGIACEÆ.

WHIDBEYELLA Setchell and Gardner gen. nov. Chætangiacearum. PLATES 23, 24.

Frond flat, membranaceous, composed of coarse filaments running longitudinally in the medulla and curving outward to the periphery, which branch di- to trichotomously and whose terminal cells form the single peripheral layer of the frond; rhizoidal filaments abundant, forming the greater portion of the thickness of the frond, slender, with somewhat of a longitudinal course; cystocarps scattered through the substance of the frond, not projecting above the surface, opening by small carpostomes on either surface, with the procarpic branch remaining and forming a distinct pedicel of several cells; fruit cavity piriform, enclosed by a wall of several layers of delicate, parallel, concentric bracteoid filaments and lined with the slender gonimoblastic filaments which send out branches into the fruit cavity, which bear the spores singly at the joints; spores ellipsoidal.

The description of this proposed genus, must necessarily remain somewhat imperfect, since we have only a single battered specimen with immature cystocarps. The structure, however, of both frond and cystocarp is so distinct that we feel fully justified in publishing it. It is intermediate between Galaxaura, which it resembles fairly closely in its cystocarp, and Chætangium which it resembles in its frond. Its structure is different from the latter in having an external tissue of a single layer of cells

and in having the gonimoblasts uniformly lining the interior of the fruit cavity, while from the former, it differs in being membranaceous and uncalcified. The name is taken from Whidbey Island, Wash., a locality furnishing us many rare plants.

Whidbeyella cartilaginea Setchell and Gardner gen. et. sp. nov. Plates 23, 24.

Plant 15 cm. high, several fronds arising from the same point; holdfast unknown; fronds narrowly cuneate below, gradually widening above and deeply lobed or parted into a few, palmate, blunt divisions which are somewhat proliferous from the margins.

Cast ashore. West coast of Whidbey Island, Wash., *N.L.G.*, No. 632!

Only a single battered specimen preserved in formalin solution is available. The color was a light red. The cystocarps are just beginning to form spores. The consistency is very firmly cartilaginous. The figures represent the habit and the structure of the plant much better than it can be described.

Family Gelidiaceæ.

Choreocolax Polysiphoniæ Reinsch.

On stems of Polysiphonia. Sitka, Alaska, *Saunders*, (1901, p. 433).

Gelidium corneum var. **lepadicola** P. & R.

Gelidium corneum var. **simplex** P. & R.

These two plants are mentioned by Postels and Ruprecht (1840, p. 16) as occurring on shells at Sitka, Alaska. We fail to find any farther information concerning them.

Gelidium Amansii Lamouroux.

On rocks, lower litoral and upper sublitoral zones. Port Renfrew, B. C., *Tilden*, No. 513!, under *G. latifolium*; East Sound, Orcas Island, Wash., *N.L.G.*, No. 522!

We are indebted to Mr. Collins for comparing Miss Tilden's plant with material from the Californian Coast referred to this species by Dr. Bornet. Similar plants have been distributed

from San Diego, California, under No. 585, Collins, Holden and Setchell, P. B.-A. (1899).

Endocladia muricata (Harvey) J. Agardh.

On stones and rocks in the upper portion of the litoral zone. Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 16); Popof Island, Alaska, *Saunders* (1901, p. 434); Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5123!; Prince William Sound, Alaska, *Saunders* (1901, p. 434); Orca, Alaska, *W.A.S. and A.A.L.*, No. 5158!; Sitka, Alaska, *Postels and Ruprecht* (1840, p. 16, under *Gigartina muricata*); Wrangell, Alaska, *Saunders* (1901, p. 434); Vancouver Island, B. C., *J. G. Agardh* (1876, p. 558, under *E. muricata* and p. 559, under *E. hamulosa*); Esquimalt, B. C., *Harvey* (1862, p. 173); Port Renfrew, B. C., *Butler and Polley*, Nos. 25, 32, and 38.

In the present species we have a plant to which the same name was given at about the same time by two different authorities. Harvey gave the name *Gigartina muricata* to a form from San Francisco in 1839 or early in 1840 as far as dates may be settled with any certainty, while Postels and Ruprecht gave the same name to a form of the same species in 1840. It has seemed best to us to take the plant of Harvey as the f. *typica* and to consider San Francisco as the type locality. This plant is well described by Harvey in the Nereis Boreali-Americana (1852, p. 182, pl. 27, B). It is more or less irregularly branched, cylindrical, and beset with spines which are simple or slightly bifid. The specimens quoted above, so far as we have seen them or so far as they are described, seem to belong to the typical form as described by Harvey and as we have found it in the neighborhood of San Francisco. The *E. hamulosa* (Ruprecht) J. Agardh seems to differ from *E. muricata* only in having the cystocarps at the bases of the ramuli, while in the latter species they are simply lateral. We have found both sorts on the same plant, so it has seemed best to include both under the older name. Harvey states that Ruprecht's *Acanthocladia muricata* is more slender and less regularly muricated than his *E. muricata* and that Ruprecht's *A. hamulosa* is identical with his *E. muricata* (loc. cit., p. 183).

Endocladia muricata f. **compressa** Setchell and Gardner f. nov.

Cylindrical below, but decidedly flattened above. Otherwise as in the typical form.

In rock pools near high water mark. Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 216!

This may possibly be the *E. complanata* Harvey from Japan, but as we have not seen a specimen of that species and, as it is described as decompositely dichotomous which ours certainly is not, we feel that this may be left with only a form name. *F. compressa* seems to be a plant of quiet waters while the type grows on exposed coasts.

Endocladia muricata f. **inermis** Setchell and Gardner f. nov.

A dwarf plant almost or quite destitute of spines.

In small tide pools at high-water mark, much exposed to sun and rain. Friday Harbor, San Juan Island, Wash., *N.L.G.*!

A very distinct form growing in short densely interlaced rigid tufts, and striking on account of its smooth or very nearly smooth frond.

Chondrus crispus (L.) Lyngbye.

On rocks in the litoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 32, under *C. platynus*); St. Michael, Alaska, Herb. *D. C. Eaton*, No. 14!, under *C. platynus*, *W.A.S.*, Nos. 5154x!, 5246y!; St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5807! (Setchell, 1899, p. 593, under *C. platynus?*); near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3290!, 4034!, 4034a!; North Pacific Ocean, *Postels and Ruprecht* (1840, p. 17).

After a careful study of the forms of Chondrus of both sides of the North American continent from the living specimens and a careful comparison of such European specimens as are available, together with such descriptions, critical notes and figures as have been published, it seems to us that the species described from our territory are better understood if placed under *C. crispus* and its various forms. It seems to us that No. 4034a, which shows young cystocarps and agrees in habit with Kjellman's

Gigartina Pacifica is really a Chondrus (since it has the cystocarpic structure of a Chondrus) and belongs under this species. We cannot feel certain of *C. platynus* (Agardh) J. Agardh, but can find no difference between it and the European species. We shall make no attempt to separate the numbers known to us into forms, but if we should do so, they would fall under several form-names.

Chondrus affinis Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 173).

We have not seen this plant from our territory, but feel that it is probably only another form of the preceding species.

Iridæa laminarioides Bory.

On rocks in the upper sublitoral zone. Puget Sound, *Saunders* (1901, p. 434); Port Renfrew, B. C., *Butler and Polley*, Nos. 44, 76, and 77.

We have not seen these specimens and consequently place them under the species without comment. Postels and Ruprecht describe (1840, pp. 17 and 18) a number of species from the North Pacific Ocean and consequently belonging, in all probability, to our territory, which are possibly forms of this species. They are placed tentatively under the various form-names in the following account according to the descriptions as given by the authors mentioned. *I. lacera* and *I. socialis* cannot even be guessed at, and *I. Cornucopiæ* is referred doubtfully to *Sarcophyllis arctica*. We have not attempted to refer several of the species noted only from Kamtschatka.

Iridæa laminarioides f. typica Setchell.

This is a form common on the Californian coast, with elongated lanceolate and, for the most part, entire frond, answering well to the description and figure of Bory (1828, p. 105, pl. 11, f. 1, especially D). It has been distributed under this name from San Francisco, California, by one of us in Collins, Holden and Setchell, P. B.-A., No. XVI (1899).

On rocks in the lower litoral zone. West coast of Whidbey Island, Wash., *N.L.G.*, No. 58!

Iridaea laminarioides f. cordata (Turner) Setchell and Gardner comb. nov.

On rocks, upper and middle litoral zones. Shumagin Islands, Yakutat Bay, and Sitka, Alaska, *Saunders* (1901, p. 434, under *I. membranacea?*; Banks Island, B. C., *Menzies* (cf. Turner, 1809, p. 118, pl. 116, under *Fucus cordatus*); Victoria, B. C., *Tilden*, Nos. 328b! (cystocarpic, under *I. laminarioides*), 328c!, (tetrasporic, under *I. laminarioides*); Esquimalt, B. C., *Harvey* (1862, under *I. cordata*); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 43b!, 102!, 180!; Channel Rocks, near Port Orchard, Kitsap County, Wash., *Tilden*, No. 329!, under *I. heterocarpa*.

We have arranged the plants mentioned above under this form only after an extended study of the Iridæas of the western coast of North America in the places where they are to be found growing in abundance. The f. *cordata* is to be distinguished by its short, broad, cordate, thick, and cartilaginous frond which may be entire or may be much lobed, either in a regular or an irregular way, and by the large (2–3 mm. broad) prominent and irregularly lobed cystocarps. It seems to us that the following species of the North Pacific Ocean may probably be placed here also, viz.: *I. heterocarpa* P. & R. (1840, p. 18) and *I. lilacina* P. & R. (loc. cit., p. 17). Saunders's plants are referred here because of his statement that they are the same as No. 329, Tilden. They do not seem to be the same as *I. membranacea* J. Agardh, at least as figured by him (1879, pl. 10, f. 1–5). That is apparently a thinner and softer plant and of decidedly different habit.

Iridæa laminarioides f. parvula Kjellman.

On rocks, on exposed shores, upper and middle litoral zones. St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5799! (Setchell, 1899, p. 593); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3253!, 4042!; "Pinnacles," Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5006!, and in Collins, Holden and Setchell, P. B.-A., No. 931!; Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5066!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5120!

A dwarf form closely approaching the preceding in its larger conditions.

Iridaea laminarioides f. punicea (P. & R.) Setchell and Gardner comb. nov.

On rocks, upper sublitoral zone. Unga, Alaska, *A.A.L.*, No. 5050!; Sitka, Alaska, *Postels and Ruprecht* (1840, p. 18); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 60!, 142!, 143!, 150!, 154!, 292!, 293!; San Juan Island, Wash., *Tilden*, No. 328a, under *I. laminarioides.*

A large form often a meter or two in length and of an exceedingly bright red purple color. It has been found with both cystocarps and tetraspores. It is not uncommon in Puget Sound and extends southward to Port Harford, San Luis Obispo County, California.

Iridæa oblongifructa Setchell

Cast ashore and growing on the stipes of Pleurophycus and Pterygophora in the sublitoral zone. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 56!, 283!

A large species, resembling *Sarcophyllis Californica* in appearance, but with oblong cystocarps. This may be a species of Callymenia, but the habit does not agree with that genus. It is found but seldom and only a few specimens are accessible to us.

Rhodoglossum latissimum J. Agardh.

In the sublitoral zone. West shore of Whidbey Island, Wash., *N.L.G.*, Nos. 101!, 140!

Only a few specimens have been found and these are cystocarpic. Consequently, the genus must remain in doubt, since the difference between Iridæa and Rhodoglossum depends upon the character of the tetrasporic sorus. The fronds are thin, the cystocarps regular and circular, and evenly distributed over the frond. It resembles in these respects the plants from the Californian coast referred to this genus. It has seemed best to us to retain J. G. Agardh's genus Rhodoglossum, since in habit, to some extent, and especially in the structure of the sorus, it is amply distinct from Iridæa.

Gigartina Pacifica Kjellman.

On rocks in the upper part of the sublitoral zone. Shumagin Islands, Alaska, *Saunders* (1901, p. 435).

The type plant is from Bering Island where Kjellman says it is fairly common. He says that it has proliferations from the disk as well as from the margins, but his figures show those from the disk only sparingly. As has been stated above, we have plants from Unalaska which agree well with Kjellman's description and figure, but the cystocarp is decidedly that of Chondrus and we have referred them to forms of *C. crispus*. We have not seen the specimens of Saunders. Near this plant, whatever its disposition, are probably to be placed Ruprecht's *Chondrus mamillosus* var. *Ochotensis* and *C. mamillosus* var. *Unalaschensis* (1851, pp. 318 and 319). The description of the latter seems to point directly to Kjellman's plant, while the former is a more slender plant. In both, the papillæ are confined to the margins and ends, and point towards forms of *C. crispus*, to which we feel inclined to refer all three plants under discussion.

Gigartina mamillosa (Goodenough and Woodward) J. Agardh.

We have long been of the opinion that the forms of Gigartina of the western coasts of North America commonly referred to *G. papillata* (Agardh) J. Agardh, are merely forms of the species of Europe and it has seemed safe to refer them under it in this paper. The type as outlined by Goodenough and Woodward (1795, p. 174) seems to be a form similar if not identical with our f. *cristata*. This species is given as from Unalaska and Sitka by Postels and Ruprecht (1840, p. 17).

Gigartina mamillosa f. **cristata** Setchell comb. nov.

On rocks in the litoral zone about half way between tide marks. Kukak Bay, Alaska, *Saunders* (1901, p. 435, under *G. papillata* f. *cristata*); Orca, Alaska, *W.A.S. and A.A.L.*, No. 5157!; Esquimalt, B. C., *Harvey* (1862, p. 172, under *G. mamillaris* f. *latissima*); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 67!, 77!, 195!; Tracyton, Kitsap County, Wash., *Tilden*, No. 219!, under *G. radula* and No. 326!, under *G. papillata* f. *cristata*.

Gigartina mamillosa f. **cristata** subf. **prolifera** Setchell and Gardner subf. nov.

On rocks in the litoral zone. Orca, Alaska, *W.A.S. and A.A.L.*, No. 5167!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5707!; Traeyton, Kitsap County, Wash., *Tilden*, No. 220!, under *G. mamillosa.*

This differs from the preceding by the papillæ being produced into lanceolate blades. It is merely a sterile foliiferous state of the preceding, but is of common occurrence on the coast of California in waters containing a considerable admixture of fresh water.

Gigartina mamillosa f. **dissecta** Setchell comb. nov.

Esquimalt, B. C., *Harvey* (1862, p. 172, under *G. mamillaris* f. *vulgaris*).

This seems to be the same as *G. papillata* f. *dissecta* Setchell.

Gigartina mamillosa f. **subsimplex** Setchell comb. nov.

On rocks in the upper litoral zone. Captains Bay, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5013!; Shumagin Islands, Alaska, *Saunders* (1901, p. 434, under *G. papillata* f. *typica*); Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5114!; Sitka, Alaska, *Ruprecht* (1851, p. 318, under *Chondrus mamillosus* var. *Sitchensis*).

This is the type of C. A. Agardh's *G. papillata*, the type specimen of which was collected by Chamisso. Chamisso labelled the plant as coming from Oahu, one of the Hawaiian Islands, but as Ruprecht (1851, p. 318) remarks, it probably came from Unalaska. It is *G. papillata* f. *subsimplex* Setchell.

Gigartina radula f. **typica** Setchell.

On rocks lower litoral and upper sublitoral zones. Puget Sound, *Bailey and Harvey* (1862, p. 162); Strait of Juan de Fuca and Victoria, B. C., *Harvey* (1862, p. 172); Port Renfrew, B. C., *Butler and Polley*, No. 73; west coast of Whidbey Island, Wash., *N.L.G.*, No. 175!

With the exception of Gardner's specimen, we assume that the references quoted belong to the typical form of this species. Gardner's specimen is near the type, but not exactly corresponding.

Gigartina radula f. microphylla (Harvey) Setchell.

Floating. West shore of Whidbey Island, Wash., *N.L.G.*, No. 64!

This plant seems to correspond to Harvey's *G. microphylla*, which one of us (cf. Setchell, in Collins, Holden and Setchell, P. B.-A., No. XIX, 1899), has already reduced to a form of *G. radula*.

Gigartina radula f. exasperata (Harvey and Bailey) Setchell.

On rocks, lower litoral and upper sublitoral zones. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 103!, 104!, 105!, 170!, 172!, 173!, 174!, 282!; Channel Rocks, near Port Orchard, Kitsap County, Wash., *Tilden*, No. 327!, under *G. spinosa*; Tracyton, Kitsap County, Wash., *Tilden*, No. 218!; opposite Fort Nisqually, Pierce County, Wash., *Harvey and Bailey* (1851, p. 371, under *G. exasperata*), *Bailey and Harvey* (1862, p. 162, under *G. exasperata*).

The *Gigartina exasperata* Harvey and Bailey (1851, p. 162, pl. 5) was founded on the young tetrasporic plant which is more thin and more ample than the adult. The adult cystocarpic plant of this species is decidedly thick and takes on the form described by Kuetzing as *Mastocarpus corymbiferus* (1867, pl. 46) and is well represented by the specimen (in our copy) under No. 327 of Tilden's American Algæ. The morphology and histology have been described by Olsen (1899) and by Humphrey (1901). Turner's figure (1808, pl. 25) of *Fucus bracteatus*, credited to the coast of Northwestern America, represents a plant intermediate between the type and this form. The young plant of this form is often a very large plant, a meter or two long and broad in proportion. As it matures it seems to become smaller and thicker. These observations were made principally on the coast of California, where this form is found in abundance.

Erythrophyllum delesserioides J. Agardh.

On rocks in the upper sublitoral zone. Vancouver Island, B. C., *Wood* in Herb. J. E. Gray (fide J. G. Agardh, 1870, p. 11); Port Renfrew, B. C., *Tilden*, No. 505!, *Butler and Polley*, No. 2.

Apparently the northern limit of this species which is abundant on the Californian coast. Miss Tilden's plant represents a young form. As growing on the Californian coast, this species at first forms a frond with smooth, veined surfaces. As the plant matures, papillæ appear on the surfaces until they are thickly covered. The tetraspores and cystocarps are formed in these papillæ in a fashion similar to the method of formation in Gigartina. Finally the surfaces wear away, leaving the veins as coarse cords covered still with papillæ. This final stage might not be recognized as belonging to the same plant as the earlier ones. The two stages have been distributed in the P. B.-A, under Nos. 50 and 588, while very young and depauperate plants have been distributed in the Phykotheka Universalis, No. 606.

J. G. Agardh, in his later work (1899, pp. 57–60), doubts the accuracy of the determination of the plants referred to this species by other algologists and finally proposes the name *Polyneura Californica* for the one distributed more recently. The two plants seem to differ, in sterile condition, by the more denticulate margin, the more simple frond, and the more completely percurrent midrib of the original plant. Our specimens, of the same age, agree perfectly with the figure given by Agardh (1879, pl. 15, f. 1) and it is possible to find in the same bunch of plants, specimens agreeing equally well with all that he has said of his *Polyneura Californica*. In view of the Gigartinaceous cystocarp, it is necessary to place this genus here rather than with the Dumontiaceæ where Schmitz placed it, and on account of the tetraspores and cystocarps being borne in papillæ or proliferations, it seems to take a position next to Gigartina.

Phyllophora Brodiæi (Turner) J. Agardh.

Arctic coast of Alaska, *Harvey* (1872, p. 463).

In Rothrock's list, Harvey reports a single specimen of a broad leaved variety of this species.

Phyllophora interrupta (Greville) J. Agardh.

Point Barrow, Alaska, *Farlow* (1885, p. 192, 1886, p. 474).

Farlow reports that fine typical specimens of this species were collected by Mr. John Murdock at this locality.

Ahnfeldtia plicata (Hudson) Fries.

On rocks in the lower litoral and upper sublitoral zones. Arctic coast of Alaska, *Harvey* (1872, p. 463); St. Lawrence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 30); St. Michael, Alaska, Herb. *D. C. Eaton*, No. 16!; St. Paul Island, Alaska, *Ruprecht* (1851, p. 326, under *Gymnogongrus fastigiatus* f. *crassior?*); Unalaska, Alaska, *Ruprecht* (1851, pp. 251 and 327, under *Gymnogongrus fastigiatus*); Kadiak Island, Alaska, *Ruprecht* (1851, p. 326, under *Gymnogongrus fastigiatus* f. *crassior*); Prince William Sound and Yakutat Bay, Alaska, *Saunders* (1901, p. 435); Sitka, Alaska, *Postels and Ruprecht* (1840, p. 16, under *Gigartina fastigiata*); North Pacific Ocean, *Postels and Ruprecht* (1840, p. 16, under *Gigartina plicata*); Esquimalt and Fuca Strait, *Harvey* (1862, p. 171); Port Renfrew, B.C., *Butler and Polley*, No. 8 (in part); Whidbey Island, *N.L.G.*, No. 30!

While it seems certain that this species is distributed along the whole coast of North America, so far as our own experience is concerned, it seems to be scarce.

We do not know what to do with Ruprecht's species *Gymnogongrus fastigiatus* and its f. *crassior*, but refer it here with a feeling that perhaps some of it may belong with the next. Schmitz (1893, p. 394) seems inclined to reckon the Ruprecht plant as a variety, at least, of *A. plicata*.

Ahnfeldtia concinna J. Agardh.

Port Renfrew, B. C., *Butler and Polley*, No. 27; west coast of Whidbey Island, Wash., *N.L.G.*, No. 35!

A coarser species and, in No. 35, provided with cystocarps. We have united under this name the *A. concinna* and the *A. Gigartinoides* of J. G. Agardh.

Sterrocolax crassior Schmitz.

On *Ahnfeldtia plicata*, apparently parasitic. St. Michael, Alaska, Herb. *D. C. Eaton*, No. 16!; Unalaska, Alaska, *Ruprecht* (1851, p. 327, as nemathecia of *Gymnogongrus fastigiatus* f. *crassior*), *Schmitz* (1877, p. 394); Kadiak Island, Alaska, *Ruprecht* (1851, p. 327, as in Unalaska specimen); Port Renfrew, B. C., *Butler and Polley*, No. 81 (in part).

It seems that this species must be very near to *S. decipiens* Schmitz or at most only a variety of it.

Callophyllis furcata f. **dissecta** Farlow in Herb.

Cast ashore from rocks in the upper litoral zone. Port Renfrew, B. C., *Tilden*, No. 325!, under *C. obtusifolia*, *Butler and Polley*, No. 109; west coast of Whidbey Island, Wash., *N.L.G.*, No. 63!

The typical form of this species, distributed by Farlow in Farlow, Anderson and Eaton, Algæ Exsiccatæ Americæ Borealis, No. 127, and by Setchell in Phycotheca Boreali-Americana, No. 883, is a broad, much forked plant with the angles very acute and the lobes approximate. The cystocarps are large and confined to the body of the frond. The tips of the lobes are obtuse. The f. *dissecta* which grades into f. *typica* is flabellately much lobed and dissected, but in color, texture, and coarseness resembles very closely the type. It is still to be settled whether *C. furcata* is to be considered as included under the *C. obtusifolia* of J. G. Agardh or not.

Callophyllis laciniata (Hudson) Kuetzing.

Esquimalt, B. C., *Harvey* (1862, p. 162); Puget Sound, *Bailey and Harvey* (1862, p. 162).

Known to us only from the two references quoted above.

Callophyllis flabellulata Harvey.

In the upper sublitoral zone, at a depth of 8–10 feet. Esquimalt, B. C., *Harvey* (1862, p. 171).

A species resembling *Euthora cristata* in habit and having the cystocarps at or very near the tips of the lobes. We have seen Californian material referred to this species, but no specimens from our territory.

Callophyllis rhynchocarpa f. **cristata** Ruprecht.

On other algæ. Unalaska, Alaska, *Ruprecht* (1851, p. 262).

Callophyllis rhynchocarpa f. **incisa** Ruprecht.

Sitka (or Unalaska?), Alaska, *Ruprecht* (1851, p. 262).

We have seen nothing resembling the forms of this species.

Callophyllis variegata (Bory) Kuetzing.

St. Paul Island, Alaska, *Ruprecht* (1851, p. 263); Esquimalt, B. C., *Harvey* (1862, p. 172).

This species, more or less common on the coast of California, is unknown to us from our territory other than as stated above. Ruprecht says that the St. Paul plant comes nearer to this species than to any other.

Callymenia reniformis (Turner) J. Agardh.

In 10 fathoms of water. Esquimalt, B. C., *Harvey* (1862, p. 172).

The only reference to this species found. It is uncertain whether this means the type of the species or not. The type form is found in some abundance at times, cast ashore at Monterey, California.

Callymenia reniformis f. **cuneata** J. Agardh.

On other algæ, in the sublitoral zone (5–10 fathoms), and cast ashore, often in considerable quantity, from deep water. Shores of the Bay of Unalaska, especially in the neighborhood of Iliuliuk, Unalaska, Alaska, *W. A. S. and A. A. L.*, Nos. 3263!, 4054!, 4089!, 4091!, 4092!, 4098!, 5047a!, and in Collins, Holden and Setchell, P. B.-A., No. 498!; Bay of Morozof (Morzhovoi Bay), Alaska, *Townsend*, No. 5777!

A fine and large plant, differing from the species in being cleft palmately into few or many, broader or narrower divisions. Both cystocarpic and tetrasporic specimens were found. In the majority of plants the margins are entire, but in some specimens they are very crispate.

Callymenia ornata (P. & R.) J. Agardh.

Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5703!

The type plant is from Kamtschatka. Ours is not so luxuriantly developed, but the comparatively long stipe, the cuneate base, the color, thickness, and lobing, point directly toward this species. Some of ours is in cystocarpic condition.

Callymenia Gmelini Grunow.

Agattu Island, Alaska, *Townsend*, No. 5757!

This plant has a certain resemblance to the last, but is smaller and differs somewhat in the structure of the cross section of the

blade. It certainly resembles the figure of Gmelin (1768, pl. 23) which Grunow (1868, p. 72) says represents the habit of the Kurile plant. Two of our plants have cystocarps which are large, projecting more on one surface than on the other, and are in structure distinctly those of a Callymenia. DeToni (1897, p. 305) is inclined to refer Grunow's species to *Phyllophora nervosa* (DC.) Greville, but our plant is certainly not a form of that species.

Callymenia Phyllophora J. Agardh.

Cast ashore from deep water. Unga, Alaska, *A.A.L.*, Nos. 5052!, 5055!, 5056b!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5119!: Kukak Bay, Alaska, *Saunders* (1901, p. 435, under *C. Californica*); Vancouver Island, B. C., *J. G. Agardh* (1870, p. 9, 1892, p. 72, under *Blastophye Phyllophora*); Port Renfrew, B. C., *Tilden*, No. 324!, under *C. Californica*, *Butler and Polley*, No. 79; west coast of Whidbey Island, Wash, *N.L.G.*, No. 43!

After a considerable study of the variations of *C. Californica* Farlow as it occurs on the western coast of North America, it has seemed best to refer it to *C. Phyllophora*. There are two series of variations of this plant, as we understand it, which shade into one another. The one may be characterized by the general orbicular shape of the main frond and its proliferations, with the margins entire or slightly ciliate. This is the type of *C. Californica*. The other series may be characterized by the elongated shape of the main frond and its divisions, with the margins, as a rule, long ciliate. This seems to be the type of *C. Phyllophora*, and is also the *Prionitis? Clevelandii* Farlow (1877, p. 242). Both types are represented in our collections, the type of Agardh from Whidbey Island, which may be distinguished as f. **typica,** while the other specimens we have seen all belong to the type of *C. Californica*, which may be distinguished as f. **orbicularis.** Some of the specimens reach a very considerable size, one leaflet of f. *orbicularis*, e. g., measuring 30 cm. in diameter. The texture of this species is much more firm than that of any other of our species of the genus, even exceeding that of *C. ornata* and forming the greatest contrast to that of *C. reniformis*.

FAMILY RHODOPHYLLIDACEÆ.

Cystoclonium gracilarioides Harvey.

Upper sublitoral zone. Esquimalt, B. C., *Harvey* (1862, p. 171); Port Angeles, Clallam County, Wash., *Lichtenthaler!*

The type specimen is sterile, but the Port Angeles specimen has cystocarps and is certainly a member of this genus, although we feel somewhat uncertain as to whether it is the species of Harvey or not. It does not seem to differ essentially from the New England forms of *C. purpurascens.*

Agardhiella tenera (J. Agardh) Schmitz.

On rocks in the upper sublitoral zone. "North West Coast," *Harvey* (1852, p. 154, pl. 23 B, under *Rhabdonia Coulteri*); Puget Sound, *Harvey and Bailey* (1851, p. 371, under *Hypnæa Coulteri*), *Bailey and Harvey* (1862, p. 162, under *Rhabdonia Coulteri*); Esquimalt, B. C., *Harvey* (1862, p. 170, under *Rhabdonia Coulteri*); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 130!, 131!; Tracyton, Kitsap County, Wash., *Tilden*, No. 217!, under *Rhabdonia Coulteri.*

There seems to be no difference between the species of the eastern and western coasts, and consequently we feel justified in assigning the *Rhabdonia Coulteri* Harvey (or *Agardhiella Coulteri* (Harvey) Setchell, in Collins, Holden and Setchell, P. B.-A., No. 333, 1897) to the *Agardhiella tenera* (J. Agardh) Schmitz.

Turnerella Mertensiana (P. & R.) Schmitz,

Cast ashore, apparently from deep water. Shumagin Islands, Alaska, *Saunders* (1901, p. 435); Unga, Alaska, *A.A.L.*, No. 5054!; Kukak Bay, Alaska, *Saunders*, No. 352!; Puget Sound, *Bailey and Harvey* (1862, p. 163, under *Iridæa Mertensiana*); Victoria, B. C., *Harvey* (1862, p. 174, under *Iridæa Mertensiana*).

We are very uncertain about the occurrence of this species within the limits of our territory. The type of the *Iridæa Mertensiana* of Postels and Ruprecht came from the Ochotsk Sea. Kjellman (1889, p. 32) found it not uncommon on the shores of Bering Island, but sterile. The plant of Harvey from Victoria was only a fragment. We have been able to examine one of

Saunders's specimens (No. 352) and have referred a fragmentary specimen from Unga here, but we suspect that they may be only specimens of *Iridæa laminarioides* f. *punicea*. They are both sterile but have a parasite, *Chlorochytrium inclusum*, which may be the "glandular cells" mentioned by Schmitz. The habit picture of Postels and Ruprecht (1840, pl. 33) does not correspond to any plant accessible to us. The figure of Kuetzing (1867, pl. 12), at least as far as figure *d* is concerned, might well represent the plant we have known under the name of *Sarcophyllis Californica*, infested with the Chlorochytrium. Our Sarcophyllis, however, belongs clearly to the Dumontiaceæ, certainly not to the Rhodophyllidaceæ. The description of the cystocarp by Schmitz (1896–1897, p. 372) also does not indicate structure sufficiently distinct from that of Sarcophyllis.

Anatheca furcata Setchell and Gardner sp. nov. PLATES 23, 24.

Frond arising from a discoid holdfast, cylindrical below (for 1–2 cm.), flattened above, and expanding upward to a length of 20 cm. and a breadth of 2–3 cm., once to thrice forked; substance thick and firm; color dark red; frond possessing a medullary tissue of fine longitudinal hyphal cells, inner cortex of large cells which suddenly become smaller in the outer cortex, while the epidermis is of small, regular, slightly palisade-like cells. Cystocarps scattered over the surfaces of the frond, prominent, hemispherical, with apical carpostome. The placenta is central and composed of large cells; the spores are in groups radiating from the placenta on all sides, and are separated from one another by strands of medullary tissue. Tetrasporangia scattered in the outer cortex, zonately divided.

Cast ashore from deep water. West coast of Whidbey Island, Wash., *N.L.G.*, No. 633!, and in Collins, Holden and Setchell, P. B.-A., No. 932, 1902!

This species might be taken for *Callophyllis furcata* f. *typica* at first glance, so great is the resemblance in habit, color, size, etc. It seems probably a member of the genus Anatheca, and very closely related to the type, *A. Montagnei* Schmitz, from the coast of Senegambia. We have been unable to examine the type

specimen, but the chief difference seems to be the more distinctly serrated margins of the Senegambian plant. Schmitz says (1896–1897, p. 374) that the spores are terminal on the sporiferous filaments. They are so situated in young specimens of our plant, but, in mature cystocarps, they are seriate.

Euthora cristata (L.) J. Agardh.

Abundant in the sublitoral zone. Shumagin Islands and Seldovia, Cook Inlet, Alaska, *Saunders* (1901, p. 435).

We have been unable to examine specimens of the plants mentioned above, but suspect that some of them, at least, may belong rather to what we take to be *E. fruticulosa*.

Euthora cristata f. typica Kjellman.

On other algæ in the upper sublitoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 27).

Kjellman finds this variety abundant at St. Lawrence Bay in Siberia, and scarce at Bering Island, Siberia and St. Lawrence Island, Alaska. He also finds a plant scarce at Bering Island which he calls f. *pinnata*, but which seems to be close to the next species.

Euthora fruticulosa (Ruprecht) J. Agardh.

Bering Sea, Herb. *University of California*; west coast of Whidbey Island, Wash., *N.L.G.*, No. 32!

These specimens are distinctly different in habit from any specimens of *E. cristata* from New England seen by us. The frond is more elongated and very distinctly pinnate. The plants are all slender and the structure is very much like that of Cystoclonium. The medulla is more distinctly filamentous, while the cortex is composed of several series of cells arranged in short filaments at right angles to the surface. The tetraspores are usually zonate, but some occur which are cruciate, while others are tripartite, and still others are combinations of zonate with either cruciate or tripartite. This occurs also in *E. cristata*.

Rhodophyllis dichotoma f. typica Kjellman,

On other algæ, in the sublitoral region. St. Lawrence Island, Alaska, *Kjellman* (1889, p, 27); St. Paul Island, Alaska, *Ruprecht* (1851, p. 593, under *Ciliaria fusca*).

We have not seen specimens of this plant.

Rhodophyllis dichotoma f. setacea Kjellman.

Unalaska, Alaska, *Ruprecht* (1851, p. 593, under *Ciliaria fusca*).

From Ruprecht's description, it seems fairly certain that his plant from Unalaska belongs under this form of Kjellman.

FAMILY SPHÆROCOCCACEAE.

Gracilaria confervoides (L.) Greville.

On rocks in the upper litoral zone. Esquimalt, B. C., *Harvey* (1862, p. 170); west coast of Whidbey Island, Wash., *N.L.G.*, No. 123!; Tracyton, Kitsap County, Wash , *Tilden*, Nos. 215!, 216!, the latter under *G. confervoides* f. *longissima*.

A common species of the coast of California, but apparently not so common on the shores of Puget Sound. We cannot see any difference between the two forms distributed by Miss Tilden. Certainly what she indicates under f. *longissima* is the ordinary form of the species and seems of equally common occurrence in Europe.

Corallopsis Salicornia (Agardh) Greville.

Unalaska, Alaska, *C. A. Agardh* (1820, pl. 8, under *Sphærococcus Salicornia*).

It is generally admitted that Chamisso must have labelled the type specimen of this species wrong. Ruprecht (1851, p. 318) makes the statement that Chamisso, himself, was doubtful as to whether he obtained the specimen at Unalaska or elsewhere.

Hypnea musciformis (Wulfen) Lamouroux.

C. A. Agardh (1821a, p. 326) gives this species a range in the Pacific Ocean from Unalaska to New Zealand. Turner (1809, p. 146) gives Nootka Sound, B. C., as the locality where Menzies collected the plant he describes under the name of *Fucus musciformis* var. *Nootkanus*. These are the sources of all other references to this plant as an inhabitant of our territory. We believe that the reference to Unalaska may have been made by Agardh under a mistaken geographical impression. Certainly Esper

(1802, p. 30) in giving the distribution of his *Fucus Nootkanus* refers to Nootka Sound as though it were in the southern hemisphere. It seems doubtful to us as to whether Turner's plant may really be *Hypnea musciformis* and there seems a possibility that it may be *Bonnemaisonia hamifera*.

FAMILY RHODYMENIACEÆ.

Fauchea laciniata J. Agardh. PLATE 25.

Rarely cast ashore. West coast of Whidbey Island, Wash., *N.L.G.*, No. 240!

This species, which occurs also on the coast of California, is represented from our territory by both tetrasporic and cystocarpic specimens. The plants have the type of frond characteristic of this species, but it is by the tetrasporic specimens that it is the more certainly told from the following.

Fauchea Gardneri Setchell. PLATE 19.

Cast ashore from deep water. West coast of Whidbey Island, Wash., *N.L.G.*, No. 45!, and in Collins, Holden and Setchell, P. B.-A., No. 933!

Readily told from the preceding, especially by the tetrasporic plant, as may be seen by comparing figure 30 on plate 19 with figure 43 on plate 25.

Rhodymenia pertusa (P. & R.) J. Agardh.

On rocks and stones, upper sublitoral zone. Point Barrow, Alaska, *Farlow* (1885, p. 192, with some doubt); Amaknak Island, Bay of Unalaska, Alaska, *Ruprecht* (1851, p. 394, under *Porphyra pertusa*); Prince William Sound and Yakutat Bay, Alaska, *Saunders* (1901, p. 436); Strait of Juan de Fuca, *Harvey and Bailey* (1851, p. 371, under *R. Wilkesii*), *Bailey and Harvey* (1862, p. 61, under the same name); Point Roberts, B. C., *Harvey* (1862, p. 171); Port Renfrew, B. C., *Butler and Polley*, No. 17; Whidbey Island, Wash., *N.L.G.*, No. 50!, and in Collins, Holden and Setchell, No. L!; in deep water near Seattle, Wash., *N.L.G.*, No. 162!; Port Orchard, Kitsap County, Wash., *Tilden*, No. A!

This is one of the most striking species of Rhodophyceæ found on our American shores. When of full size, it is 40–60 cm. long, and 15–20 cm. wide, more or less regularly perforated. The tetrasporic plant is smooth and usually more ample than the cystocarpic plant, which is covered with the dark, prominent, medium-sized cystocarps. Some plants have peculiar proliferations from the margins and surfaces, which look like the stipes of the adult plants. They have rounded tips when younger, but later produce miniature blades. It is probable that they may, under proper circumstances, grow into new plants. The perforations appear on any portion of the frond, new ones being formed among the older ones. Their formation seems to be accompanied by the destruction of tissue, probably much as in Agarum as described by Humphrey (1886). The morphology and anatomy of this species have been treated somewhat superficially by Butters (1899). He had only the cystocarpic plant. The tetrasporangia are born in the subepidermal tissues and are tripartite or cruciate. They are scattered irregularly over the plant.

Rhodymenia palmata (L.) Greville.

On rocks in the upper sublitoral zone. Popof Island, Kukak Bay, Prince William Sound, Yakutat Bay, and Glacier Bay, Alaska, *Saunders* (1901, p. 436); Esquimalt and the Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 171).

These references are evidently all to the f. *typica*, that of Harvey probably mostly to subf. *nuda*. while those of Saunders refer both to that subform and subf. *marginifera*. The specimens examined by us have been referred to their proper subforms as follows.

Rhodymenia palmata f. typica subf. **nuda** Kjellman.

On stones in the lower litoral and upper sublitoral zones. Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3264!, 5000!, and in Collins, Holden and Setchell, P. B.-A., No. 936!; Karluk, Kadiak Island, Alaska, *W.A.S.*, No, 5064!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5079b!

Apparently perfectly typical of this form. It is a cartilaginous, thick, deep red form without marginal proliferations.

Rhodymenia palmata f. **typica** subf. **marginifera** Harvey.

On rocks in the middle litoral zone. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5007!, *Postels and Ruprecht* (1840, p. 18).

Similar to the last in texture, usually of a paler color, and with the characteristic proliferations from the margins.

Rhodymenia palmata f. **typica** subf. **linearis** Setchell and Gardner subf. nov.

Fronds gregarious, simple, without proliferations, elongated linear-lanceolate, 30–65 cm. long and 1–2 (occasionally up to 3) cm. wide; substance cartilaginous; color deep red.

On rocks in the upper sublitoral zone. Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5709!

An extraordinary variation of this form. Mr. Johnson says that it is eaten by the natives at Yakutat Bay and that the Thlinket name is "Raa-ts."

Rhodymenia palmata f. **mollis** Setchell and Gardner f. nov.

Fronds gregarious, simple or palmately lobed or cleft, more or less linear-lanceolate to broadly ovate in general outline, 20–40 cm. long and 5–15 cm. wide, dull reddish purple in color, and of more or less fleshy consistency. Tetraspores commonly present, cruciate, situated among the filaments of the outer layer.

On rocks, forming a zone at low water mark. Agattu Island, Alaska, *Townsend*, No. 5759!; Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*! (a fragment); Esquimalt, B. C., *Tilden*, No. 304!, under *Grateloupia Cutleriæ*; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 178!, 181!, 623!, and in Collins, Holden and Setchell, P. B.-A., No. 934!

This form is very different from f. *typica* in color and consistency, but resembles it closely in shape. In structure, too, the two forms are very similar, but f. *mollis* is very commonly tetrasporic, while our specimens of f. *typica* are largely sterile. The base of f. *mollis* is more cartilaginous than the portions

above and, consequently, often persists after the upper parts are worn away. It is fairly common in various localities in Puget Sound, for one of us (N.L.G.) has found it on the Washington side of the Strait of Juan de Fuca, near Port Townsend, and on San Juan Island. We have collected specimens which we are inclined to refer to this form on the Californian coast near San Francisco and near Monterey. These more southern forms proliferate more commonly than the northern forms. This form is known as "Dulse" to many people in the Puget Sound region and is collected, particularly by the Canadian residents, in some quantity, and used as a relish.

Rhodymenia palmata f. Sarniensis (Mertens) J. Agardh.

On rocks, forming a zone in the middle litoral zone. Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5065!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5076!, and in Collins, Holden and Setchell, P. B.-A., No. 935!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5144!; Orca, Alaska, *W.A.S. and A.A.L.*, No. 5166!

The plants placed under this form are very distinct from the preceding forms of this species, but intergrade with them. It is near to f. *sobolifera* (Fl. Dan.) J. Agardh, which, if distinct from this, may possibly be found among the plants referred here.

Rhodymenia Palmetta (Esper) Greville.

Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 171).

Known to us only from this reference.

Rhodymenia corallina (Bory) Greville.

Reported as growing in 14 fathoms of water in the Strait of Juan de Fuca, on the British Columbia side, by Harvey (1862, p. 171), with some doubt as to the determination.

Lomentaria ovalis f. subarticulata (Turner) Harvey.

Nootka Sound, B. C., *Menzies* (Turner, 1809, p. 24, pl. 81, under *Fucus ovalis* var. *subarticulatus*); Tracyton, Kitsap County, Wash., *Tilden*, No. 214!, under *L. ovalis* var. *Coulteri;* East Sound, Orcas Island, Wash., *N. L. G.*!

Apparently a rare plant in our territory.

Plocamium violaceum Farlow.

Port Renfrew, B. C., *Butler and Polley*, No. 33!

Determined by F. S. Collins.

Plocamium coccineum (Hudson) Lyngbye.

On rocks and algæ in the upper litoral zone. Puget Sound, *Bailey and Harvey* (1862, p. 161); Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 171); Port Renfrew, B. C., *Butler and Polley*, Nos. 34, 36, and in Collins, Holden and Setchell, P. B.-A., No. 994d!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 39!, 73!

Plocamium coccineum f. **uncinatum** J. Agardh.

In the sublitoral zone. Sitka, Alaska. *Saunders* (1901, p. 436).

Halosaccion glandiforme (Gmelin) Ruprecht.

An extended study of the saccate species of this genus has convinced us that, so far as the North Pacific species are concerned, the characters depended upon for separation from one another may be ascribed to difference of age, habitat, etc., and it has seemed best, consequently, to consider them all as belonging to one polymorphous species. We are not able even to divide this mass of forms into satisfactory groups and follow Ruprecht in adopting Gmelin's name as the earliest. We shall not attempt to give any complete view of the synonymy, at this time, but much of it may be found in Ruprecht's able discussion of the genus (1851, pp. 179–295). We shall arrange the references to localities in our territory under the specific names used as follows:—

Halosaccion glandiforme f. *coriaceum*. Kadiak Island and Unalaska (?), Alaska, *Ruprecht* (1851, p. 292).

Halosaccion glandiforme f. *genuinum*. Kadiak Island, Alaska, *Ruprecht* (1851, p. 293).

Halosaccion glandiforme f. *Menziesii*. Nootka Sound, B. C., *Ruprecht* (1851, p. 293).

Halosaccion glandiforme f. *soboliferum*. Sitka, Alaska, *Ruprecht* (1851, p. 292).

Halosaccion fucicola. Unalaska and Sitka, Alaska. *Ruprecht* (1851, pp. 289, 293); Popof Island, Prince William Sound, Sitka, and Annette Island, Alaska, and Victoria, B. C., *Saunders* (1901, p. 436).

Halosaccion fucicola f. *radicans.* Unalaska, Alaska, *Ruprecht* (1851, p. 293).

Halosaccion fucicola f. *decapitatum.* Kadiak Island and Sitka, Alaska, *Ruprecht* (1851, p. 293).

Fucus saccatus. Nootka Sound, B. C., *Turner* (1819, p. 104).

Halosaccion Hydrophora. Puget Sound, *Bailey and Harvey* (1862, p. 162); Esquimalt, B. C., and Strait of Juan de Fuca, *Harvey* (1862, p. 162).

Halosaccion firmum. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 29); Cook Inlet, Alaska, *Saunders* (1901, p. 436).

Dumontia fucicola. Sitka, Alaska, *Postels and Ruprecht* (1840, p. 19).

Dumontia decapitata. Sitka, Alaska, *Postels and Ruprecht* (1840, p. 19).

The specimens examined by us may be reported as follows:—

On rocks and algæ in the litoral zone. Agattu Island, Alaska, *Townsend,* No. 5758!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3266!; Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos 4051!, 4061!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5115!; St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5147!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5704!; Port Renfrew, B. C., *Tilden*, No. 511!, under *H. fucicola*, *Butler and Polley*, Nos. 10, 105; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 4!, 285!; San Juan Island, Wash., *N.L.G.*, 108!, *Tilden*, No. 242!, under *Adenocystis Lessonii.*

Halosaccion glandiforme, in our extended sense, ranges from the Sea of Ochotsk to the east and southeast along the coasts of North America down to the northwestern coast of Mexico. The typical form is a large finger-shaped sack filled, when fresh, with water. There are microscopical openings at the tip or near it so that when one compresses the sack below, the water spurts out

in a number of very fine jets. This fact is mentioned by Turner (1819, p. 104) who quotes from the description of Tilesius of *Fucus saccatus*, and by Ruprecht (1851, p. 283). This is possible only when the plant is young. As the plant becomes older, the walls of the sack thicken, the color becomes darker, or else fades, and the tip is torn away or eroded, and the whole sack or a portion of it becomes filled with sand. All of these changes due to age, and the variability in color and size have brought about the considerable and vexatious synonymy.

Halosaccion ramentaceum (L.) J. Agardh.

In the litoral and upper sublitoral zones, on rocks and algæ. Sannak Island, Alaska, *Turner* (1886, p. 85, specimen in Herb. D. C. Eaton!); Kukak Bay, and Cook Inlet, Alaska, *Saunders* (1901, p. 436); Yakutat Bay and Glacier Bay, Alaska, *Saunders* (1901, p. 436, under *H. microsporum*).

We feel certain that *H. microsporum* is to be included under *H. ramentaceum* and have, in consequence, placed the two sets mentioned by Saunders under the one name, although we have not seen any of his *H. microsporum*.

Halosaccion Tilesii Kjellman.

In the litoral zone. Kukak Bay, Prince William Sound, Yakutat Bay, and Wrangell, Alaska, *Saunders* (1901, p. 436).

We have not seen any of the plants referred by Saunders to this species. The species occurs in two forms at Bering Island, Siberia, and as Kjellman has defined it, it is to be distinguished from the preceding species by its di- to polychotomous branching. Kjellman's figures (1889, pl. 1, f. 16–19), however, seem to represent a flat plant, tubular only at the base, and resemble very much the plants we have referred to *Rhodymenia palmata* f. *Sarniensis*.

Halosaccion coronatum (P. & R.) Kuetzing.

The *Dumontia coronata* and the *D. Clava* of Postels and Ruprecht, given as occurring among algæ of the Russian shores of the North Pacific Ocean, are puzzles. Ruprecht (1851, p. 286) says that they show no algal structure and is inclined to refer them to the animal kingdom, while *D. furcata* P. & R. is *Gloiopeltis furcata*.

FAMILY DELESSERIACEÆ.

Nitophyllum Harveyanum J. Agardh.

Puget Sound, *Nott* (1900, p. 31).

Known only by a single specimen from our territory. The species is Australian, and also occurs locally in several localities on the Central Californian coast.

Nitophyllum latissimum (Harvey) J. Agardh.

On stones and wood in the lower litoral and upper sublitoral zones. Esquimalt, B. C., *Harvey* (1862, p. 170, under *Hymenena latissima*); west coast of Whidbey Island, Wash., *N.L.G.*, No. 93!; Port Orchard, Kitsap County, Wash., *Tilden*, No. 212!

A variable species, especially as to outline, prominence or obsolescence of the veins, color, etc. Miss Tilden's specimen is very fragmentary, representing a proliferation of an old plant, but seems to belong here. Harvey's plants, the types, are separated into two species by J. G. Agardh, the second of which is his *N. stenoglossum* (cf. J. Agardh, 1898, p. 92), but which we are inclined to refer to *N. violaceum*. Gardner's plant belongs to the *N. macroglossum* of J. Agardh, but, as Nott has already shown, is probably only a seasonal variation of *N. latissimum* (cf. Nott, 1900, pp. 19, 20).

Nitophyllum Ruthenicum (P. & R.) Kjellman.

On various Laminariaceæ in the sublitoral zone. St. Paul Island, Alaska, Herb. Farlow, legit *White*! (Setchell, 1899, p. 594); Sitka, Alaska, *Saunders* (1901, p. 437); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 114!, 115!, 266!.

This species is intermediate between what passes for *N. Fryeanum* and *N. spectabile* D. C. Eaton. The veins are inconspicuous and often scanty, and confined, as a rule, to the very base of the frond. Saunders (loc. cit.) speaks of this species as being intermediate between *N. latissimum* and *N. Fryeanum*. We have compared our specimens with specimens kindly sent by Professor Kjellman, and can find nothing in common with *N. latissimum*.

Nitophyllum violaceum J. Agardh.

On rocks in the lower litoral and upper sublitoral zones. Vancouver Island (probably at Esquimalt), B. C., *J. G. Agardh* (1898, p. 92, under *N. stenoglossum*); Port Renfrew, B. C., *Tilden*, No. 321! under *N. multilobum*.

A very variable species as regards habit and somewhat as regards color. As the sori appear in almost all younger plants on the margins and even on the surfaces of the lobes, appearing later on marginal leaflets, it does not seem desirable to remove this species from Nitophyllum and place it in Botryoglossum as DeToni has done. Miss Tilden's plant, although cystocarpic, seems clearly of this species, and would probably have been referred to *N. stenoglossum* by J. G. Agardh.

Nitophyllum Ruprechtianum J. Agardh.

On other algæ in the upper sublitoral zone. St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5802! (Setchell, 1899, p. 594); Norfolk Sound (near Sitka), Alaska, *Postels and Ruprecht* (1840, p. 15, under *Hymenena fimbriata*); Victoria and Esquimalt, B. C., *Harvey* (1862, p. 170, under *Hymenena fimbriata*); Port Renfrew, B. C., *Butler and Polley*, Nos. 22, 108; and in Collins, Holden and Setchell, P.B.-A., No. 937!; Puget Sound, *Bailey and Harvey* (1862, p. 161, under *Hymenena fissa* and *Botryocarpum platycarpum*); west coast of Whidbey Island, Wash., *N.L.G.*, No. 267!; Port Orchard, Kitsap County, Wash., *Tilden*, No. 213!

N. Ruprechtianum is another species, in which the sori are arranged differently in the younger from what they are in the older plants. At the tips, the sori commonly form flabellate lines along the veins in the substance of the fronds. This is the *N. flabelligerum* J. Agardh, and is represented by No. 108 from Port Renfrew. Later, the sori occupy marginal leaflets. Consequently, there seems to be no reason for placing this species under Botryoglossum as DeToni has done.

Delesseria intermedia J. Agardh.

Vancouver Island, B. C., *J. G. Agardh* (1870, p. 55).

Known to us only from Agardh's description.

Delesseria sinuosa (Goodenough and Woodward) Lamouroux.

Arctic coast of Alaska, *Harvey* (1872, p. 463); Agattu Island, Alaska, *Townsend*, No. 5764!; shores of the Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3274!, 4038!, 4064a!, 5005!; Shumagin Islands, Alaska, *Saunders* (1901, p. 437); Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5063!; Cormorant Rocks, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5134!; Kukak Bay, Prince William Sound, and Sitka, Alaska, *Saunders* (1901, p. 437).

The specimens examined by us, of those enumerated above, show more or less proliferation, and in most cases, they are eroded to the costa and ribs which are bare or nearly bare of blade, but covered with smaller or larger proliferous leaflets. Unfortunately, none of the specimens have either tetraspores or cystocarps, and consequently we cannot be so certain as to the specific determination as we desire. Our specimens are placed here on account of the tendency to proliferate. We do not feel certain of Saunders's conception of the species, since he says (loc. cit.):—"a very variable species, some of the forms resembling *D. quercifolia* but with a more distinct midrib and opposite nerves." *D. quercifolia*, however, has a fairly distinct midrib and the nerves are opposite.

Delesseria sinuosa f. **lingulata** Agardh.

Upper sublitoral zone. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 25).

Kjellman found the f. *typica* at Bering Island Siberia, and these specimens bore cystocarps, while the St. Lawrence Island specimens bore tetrasporangia.

Delesseria crassifolia Ruprecht.

St. Paul Island, Alaska, *Ruprecht* (1851, p. 232), *Farlow* (1886, p. 473), *Townsend*, No. 5779!, *Greeley and Snodgrass*, No. 5803! (Setchell, 1899, p. 594), *Saunders* (1901, p. 437).

A fine large species and apparently commonly cast ashore at St. Paul Island in the Pribilof group. It seems close to *D. Middendorfii* Ruprecht, but is less proliferous from the costa.

Schizoneura quercifolia f. **linearis** Collins comb. nov.

On stipes of Lessonia in the upper sublitoral zone. Port Renfrew, B. C., *Butler and Polley*, in Collins, Holden and Setchell, P. B.-A., No. 938!

Collins has distributed the specimens collected at Port Renfrew under the name of *Delesseria quercifolia* f. *linearis*. The plants look like eroded and less proliferous forms of the Unalaska plants which we have referred to *D. sinuosa*. In general outline and venation, these several plants resemble *S. quercifolia* very much, but that species as found on the coast of California does not show, in the specimens seen by us, any tendency towards proliferation. As none of the specimens are in fruit, we must leave them as given here.

Erythroglossum Woodii J. Agardh.

Vancouver Island, B. C., *J. G. Agardh* (1870, p. 54, under *Delesseria Woodii*).

We have not seen any specimen which may be referred to this species. According to the description, it has a narrow, linear frond (2–3 mm. wide), pinnately branched, with interrupted, linear, marginal sori.

Apoglossum decipiens J. Agardh.

Upper sublitoral zone. Prince William Sound, Alaska, *Saunders* (1901, p. 437, under *Delesseria decipiens*); Vancouver Island, B. C., *J. G. Agardh* (1870, p. 58, under *Delesseria decipiens*); Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 170, under *D. Hypoglossum* var. *arborescens*); Whidbey Island, Wash., *N.L.G.*, No. 6!; San Juan Island, Wash., *Tilden*, No. 211!, under *D. decipiens*.

A large and beautiful species with both cystocarps and tetraspores in abundance, extending southward to the central coast of California.

Pteridium Bærii (Ruprecht) J. Agardh.

In the sublitoral zone. Sitka, Alaska, *Saunders* (1901, p. 437, under *D. Bærii*).

This species occurs in the Ochotsk Sea, but the above is the only locality as yet noted for it on the West American Coast.

Pteridium Juergensii J. Agardh.

St. Paul Island, Alaska, *Ruprecht* (1851, p. 245, under *Delesseria complanata*), *Farlow* (1886, p. 473. under *D. Juergensii*); Unalaska, Alaska, *Ruprecht* (1851, p. 245, under *D. complanata*); Sannak Island, Alaska, *Turner* (1886, p. 85, under *D. Juergensii*).

We have not seen a specimen.

Pteridium spinulosum (Ruprecht) J. Agardh.

St. Paul Island, Alaska, *Ruprecht* (1851, p. 244, under *D. Beeringiana* f. *spinulosa*); Bay of Morozof (Morzhovoi Bay), Alaska, *Townsend*, No. 5776!

We have ventured to refer here a narrow, sterile plant, but not without some doubt. J. G. Agardh (1876, p. 483) leaves it to be understood that he knows nothing of the sori of this species and DeToni (1900, p. 714) says: "fructibus ignotis," but Ruprecht says distinctly (1851, p. 244), that the somewhat young tetraspores, in a specimen from St. Paul form a long line, on each side of the midrib, extending from near the base of a branch very nearly to the tip.

Pteridium alatum (Hudson) J. Agardh.

Victoria, B. C., *Saunders* (1901, p. 437, under *Delesseria alata*); on stems of Nereocystis, probably near Esquimalt (no special locality given). B. C., *Harvey* (1862, p. 437, under *D. alata* var. *latissima*).

We have seen no specimens of this species from our territory and simply quote the above localities. The narrow Delesserieæ of our coast need more careful study and revision.

Pteridium? serratum (P. & R.) DeToni.

St. Paul Island, Alaska, *Ruprecht* (1851, p. 245, under *Delesseria serrata*); Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 15, under *D. serrata*); Alaska, *Saunders* (1901, p. 438, under *D. serrata*).

Ruprecht states that his plants grew generally on *Ptilota Asplenioides*, but Saunders gives neither habitat nor exact locality.

Pteridium? serratum f. **platyphyllum** Setchell and Gardner f. nov.

Fronds up to 10 cm. high, subdichotomous below, regularly alternately pinnate above, rose red, linear, entire, with prominent midrib and microscopic lateral veins. The width varies from 5 mm. in the lower part, to 2 mm. just below the tips of the branches. Sori on each side of the midrib and ascending along the microscopic veins, continuous from near the base to just below the tips. Cystocarps?.

On a wooden float. Pleasant Beach, Kitsap County, Wash., *N.L.G.*, No. 344!

Answering very well to the description of *Pt. serratum*, except that the frond is twice as wide and the margins smooth. The plant has the color and consistency of *Apoglossum decipiens*, but differs decidedly in its method of branching (we have seen no proliferations of any kind) and the position of the sori. We have seen what appears to be the same form from Santa Cruz, California, collected by Dr. C. L. Anderson. We refer this form to *Pteridium serratum* with considerable doubt, since we have been unable to examine a specimen of that species.

FAMILY BONNEMAISONIACEÆ.

Bonnemaisonia hamifera Hariot.

In the upper sublitoral zone. West coast of Whidbey Island, Wash., *N.L.G*,, No. 25!, and in Collins, Holden and Setchell, P. B.-A., No. 939!

This species varies very much in breadth and the frequency of the circinate branchlets. Some specimens are as much as 6 mm. broad, while others are not over 1.5 mm. even in the broadest portions. The Whidbey Island specimens show cystocarps, antheridia, and tetrasporangia. It is to be found from May until August.

Family RHODOMELACEÆ.

Laurencia pinnatifida (Gmelin) Lamouroux.

On rocks in the lower litoral and upper sublitoral zones. Norfolk Sound (near Sitka), Alaska, *Postels and Ruprecht* (1840, p. 16, under *L. spectabilis*); Strait of Juan de Fuca and Victoria, B. C., *Harvey* (1862, p. 169); Port Renfrew, B. C., *Tilden*, No. 320!, *Butler and Polley*, No. 116; west coast of Whidbey Island, Wash., *N.L.G.*, No. 449!

A common species of the coast of California.

Janczewskia verrucæformis Solms.

Parasitic on the fronds of the preceding species. West coast of Whidbey Island, Wash., *N.L.G.*, No. 449a!

Not uncommon on the coast of California.

Chondria atropurpurea Harvey.

Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 168).

Known from our territory only from this reference.

Polysiphonia atrorubescens (Dillwyn) Greville.

In the sublitoral zone (10 fathoms). Strait of Juan de Fuca and Esquimalt, B. C., *Harvey* (1862, p. 168).

We have not seen any specimens referable to this species.

Polysiphonia atrorubescens f. minor Harvey.

Orcas Island, Wash., *Harvey* (1862, p. 168).

Polysiphonia nigrescens f. Fucoides Harvey.

Sitka, Alaska, *Harvey* (1852, p. 50).

Polysiphonia urceolata (Lightfoot) Greville.

On boulders near low water mark. Strait of Juan de Fuca, Point Roberts, and Esquimalt, B. C., *Harvey* (1862, p. 169); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 224!, 3225!, 409!; Channel Rocks, near Seattle, Wash., *N.L.G.*, No. 349!

The specimens examined have no leaves and seem to correspond in every way to the description of this species.

Polysiphonia senticulosa Harvey.

Orcas Island, Wash., *Harvey* (1862, p. 169).

This is the type locality for this species. We have seen no plants from our territory which we can refer to it. The species is placed near *P. urceolata* by J. G. Agardh (1863, p. 974), but is to be distinguished by the terminal branchlets being densely pinnately virgate. If the specimen distributed in Collins, Holden and Setchell's Phycotheca Boreali-Americana (No. 638) is correctly determined, this species differs from the last, not only in the last mentioned particulars, but also in having short but well developed leaves towards the tips both of the main shoot and of the lateral axes.

Polysiphonia Californica Harvey.

On rocks and wood, upper sublitoral zone. Esquimalt, B. C., *Harvey* (1862, p. 168); Whidbey Island, Wash., *N.L.G.*, Nos. 127!, 297!; San Juan Island, Wash., *Tilden*, No. 316!, under *P. atrorubescens;* Pleasant Beach, Kitsap County, Wash., *N.L.G.*, No. 347!; Tracyton, Kitsap County, Wash., *Tilden*, No. 210!, under *P. bipinnata*.

We have made a careful examination of all specimens from our territory with many pericentral cells, accessible to us, of the species of Polysiphonia as limited by Falkenberg (1901). The specimens referred to the present species all agree in having monosiphonous, colorless, simple branchlets (simple leaves?) near the tips of the young axes as Falkenberg has indicated for the type (1901, p. 274). In habit and other details of structure, the plants referred here seem to agree well with the description of Harvey (1852, p. 58) and they also agree well with plants collected by us near the type locality and referred here. The relation between this species and *P. atrorubescens* and *P. nigrescens* seem likely to be close, but the simple leaves and some differences of habit prevent our referring the specimens to either of these species at present.

Polysiphonia Californica var. **plumigera** Harvey.

Point Roberts, B. C., *Harvey* (1862, p. 168).

Pterosiphonia bipinnata (P. & R.) Falkenberg.

On rocks and algæ in the litoral and upper sublitoral zones. Cape Nome, Alaska, *W. A. S.*, No. 5732! (cast ashore); St. Michael, Alaska, *W. A. S.*, No. 5242x!, in Herb. *D. C. Eaton*, No. 13!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W. A. S. and A. A. L.*, No. 3257!; near Iliuliuk Unalaska, Alaska, *W. A. S. and A. A. L.*, Nos. 4054b!, 5009!, 5014!; Uyak Bay, Kadiak Island, Alaska, *W. A. S. and A. A. L.*, No. 5094!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W. A. S. and A. A. L.*, Nos. 5108!, 5135!; St. Paul, Kadiak Island, Alaska, *W. A. S. and A. A. L.*, No. 5143!; Orca, Alaska, *W. A. S. and A. A. L.*, No. 5163!; Port Renfrew, B. C., *Butler and Polley!*; Whidbey Island, Wash., *N. L. G.*, No. 20!; San Juan Island, Wash., *N. L. G.*, No. 211!, *Tilden*, No. 318!, under *P. nigrescens*.

Besides the localities given above, from which we have carefully studied specimens, Saunders has given (1901, p. 438) the following localities for *P. bipinnata*: Yakutat Bay, Glacier Bay, Sitka, and Annette Island, Alaska. We have segregated the last localities, since there has been some confusion as to the real plant of Postels and Ruprecht, but Falkenberg (1901, pp. 273, 274) has indicated the structure and removed from it *Polysiphonia Californica* Harvey which has commonly been referred to it as a synonym on the authority of J. G. Agardh. The type is a leafless, slightly or not at all flattened species with distichously pinnate branching, at least in the upper portions. The pericentral cells vary from 11 to 18.

Pterosiphonia dendroidea (Montagne) Falkenberg.

On rocks and algæ in the lower litoral and upper sublitoral zones. Esquimalt, B. C., *Harvey* (1862, p. 168, under *Polysiphonia dendroidea*); west coast of Whidbey Island, Wash., *N. L. G.*, Nos. 176!, 237!, 238!, 511a!

A very distinct species sometimes placed under *Pol. parasitica* as a variety, but kept distinct by Falkenberg. What appear to be younger specimens have sometimes been referred to *Pterosiphonia pennata* (Roth) Falkenberg, and Falkenberg (1901, p. 264) has seen a specimen from San Simeon Bay, San Luis Obispo County, Cal., which may be the Peruvian *Pol. spinifera* Kuetzing.

Pterosiphonia Woodii (Harvey) Falkenberg.

On the stipes of Pleurophycus and other kelps in the upper sublitoral zone. Port Renfrew, B. C., *Butler and Polley*, No. 1!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 12!, 38!

More or less common on the shores of California.

Pterosiphonia arctica (J. Agardh) Setchell and Gardner comb. nov. PLATE 19.

On large algæ in the upper sublitoral zone or floating. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5002!; Shumagin Islands, Alaska, *Saunders* (1901, p. 438, under *Polysiphonia arctica*); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 59!, 226!, 227!, 413!, 511!

We are uncertain as to the type of *Polysiphonia arctica* J. Agardh, but we have been able to compare ours with a specimen from Rosenvinge, through the kindness of F. S. Collins. This specimen was old and battered and there was difficulty in obtaining good tips. Ours seemed to be very close to it and consequently we have placed it under this name. Our plants vary much in coarseness, are plainly distichous near the tips, have constantly six or seven pericentral cells, and have the tips mucronate and devoid of hairs. Our figures show the Alaskan specimens which are coarser than those from Puget Sound. We have not seen the plant of Saunders. Our plants are certainly good species of Pterosiphonia as Falkenberg has described the genus.

Lophosiphonia obscura (Agardh) Falkenberg.

On sand covered rocks in the litoral zone. San Juan Island, Wash., *Tilden*, No. 317, under *Polysiphonia bipinnata* f. *psammicola*.

This species is quite common on the coast of California. It answers well to the descriptions of this species and has been compared with European specimens by F. S. Collins.

Lophosiphonia villum (J. Agardh) Setchell and Gardner comb. nov.

On Fucus, lower litoral zone. St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5138!

A single plant, looking so much like a luxuriant Rhodochorton that at first it was taken for one, resembles so closely what we have considered to be *Polysiphonia villum* on the Californian coast that it is referred to the same species. The *P. villum* of J. G. Agardh is undoubtedly a Lophosiphonia as established by Falkenberg, and, consequently, we are compelled to place the species under that genus. Our Alaskan plant is the same as No. 246 of Collins, Holden and Setchell, P. B.-A., but is not the same as the *Pol. villum*, No. 134 *bis* of Farlow, Anderson and Eaton, Alg. Exsicc. Am. Bor. Our plants have no leaves, while the last mentioned plant has well developed leaves at the bases of the secondary branches. We are uncertain as to which, if either, of these plants is the type, but believe that ours corresponds more nearly to the description. In our plant, the creeping, rhizoid-bearing stem bears longer or shorter branches along the upper surface. The branches are sparingly branched, in turn, and are endogenous in origin. The tips are attentuate and slightly recurved, bearing no hair like growths.

Rhodomela Larix (Turner) Agardh.

On rocks, on exposed shores in the litoral zone. St. Paul Island, Alaska, *Ruprecht* (1851, p. 219, under *Fuscaria Larix*); west coast of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3251!; Unalaska and Norfolk Sound (Sitka), Alaska, and Nootka Sound, B. C., *Postels and Ruprecht* (1840, p. 14); Nootka Sound, B. C., *Turner* (1819, p. 23, pl. 207, under *Fucus Larix*); Puget Sound, *Bailey and Harvey* (1862, p. 160); Point Roberts, Strait of Juan de Fuca, and Esquimalt, B. C., *Harvey* (1862, p. 168); Port Renfrew, B. C., *Butler and Polley*, No. 4; west coast of Whidbey Island, Wash., *N.L.G.*, No. 46!; San Juan Island, Wash., *Tilden*, No. 209!

A robust species with the branchlets arising spirally on the main axes and to be distinguished from the various forms of *Odonthalia floccosa* by this character. Turner's figure (1819, pl. 207, f. a.) of the habit represents a plant rather more pinnate than any seen by us, but otherwise our plants are in agreement with it. The figure of Postels and Ruprecht (1840, pl. 38, f. h.) is small but represents a typical plant. Kuetzing's figure (1865,

pl. 39, f. a.), however represents, as it seems to us, a form of *Odonthalia floccosa*. This species is very common along the coast of California.

Rhodomela Lycopodioides f. Cladostephus (J. Agardh) Kjellman.

On stones in quiet water, upper sublitoral zone. East shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4079!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5706!

We have found a number of forms of a species which cannot be referred to *R. Larix* or to *Odonthalia floccosa* and, after careful study, we are convinced that all, or perhaps nearly all, are to be referred to *R. Lycopodioides*. They are puzzling forms and we are occasionally in some considerable doubt about some particular plant. Kjellman's account in the Algæ of the Arctic Sea has been of great help and we have referred our forms much as he has done. The present form is a coarse one and may have passed as a slender form of *R. Larix*. It differs from that species in being more regularly and more pinnately branched and has a much more regular distribution of branchlets.

Rhodomela Lycopodioides f. typica subf. **compacta** Kjellman.

On stones in the middle litoral zone. St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, Nos. 5142! (cystocarpic!), 5146! (tetrasporic!).

This form is less coarse, not so rigid and wiry, and less Cladostephus-like than the last, but it is decidedly more densely provided with branchlets than the next. It has the intensely black color, when dried, common to all the members of this group of forms.

Rhodomela Lycopodioides f. typica subf. **laxa** Kjellman.

On rocks in the litoral zone. St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5796a!; Bay of Unalaska, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5017a!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5074!; Orca, Alaska, *W.A.S. and A.A.L.*, No. 5162!; Yakutat Bay, Alaska, *Rev. Albin Johnson*, No. 5710!; Sitka, Alaska, *Ida M. Rodgers*, No. 5726!

This form, and, to some extent, the last, resembles some of the forms of *Odonthalia Aleutica*, but are more slender and have the branchlets even from the very first, spirally arranged. However, it is not always easy to determine this from dried specimens. We have examined carefully every specimen referred here and feel fairly certain that all belong under this name.

Rhodomela Lycopodioides f. typica subf. **tenera** Kjellman.

Golofnin Bay, Alaska, *R. C. McGregor*, No. 5674!

This plant agrees fairly well with Kjellman's figure of this form (1883, pl. 9, f. 2).

Rhodomela Lycopodioides f. flagellaris Kjellman.

Golofnin Bay, Alaska, *R. C. McGregor*, Nos, 5672!, 5677!

We refer here plants which seem to agree well with Kjellman's figure of this form (1883, pl. 10, f. 1).

Rhodomela Lycopodioides f. ramentacea Kjellman.

In the upper sublitoral zone. Port Clarence, Alaska, *Kjellman* (1889, p. 24); Golofnin Bay, Alaska, *R. C. McGregor*, No. 5675!

We refer the Golofnin Bay specimen here very doubtfully, since it is only a fragment, but it has something of the habit of *Chordaria abietina* described for this form.

Rhodomela Lycopodioides f. tenuissima (Ruprecht) Kjellman.

St. Lawrence Island and Port Clarence, Alaska, *Kjellman* (1889, p. 24, subf. *prolifera*); Cape Nome, Alaska, *W.A.S.*, No. 5731! (cast ashore); Golofnin Bay, Alaska, *R. C. McGregor*, No. 5666a!.

From f. *Cladostephus* to f. *tenuissima* is a very considerable jump and were it not for the intermediate forms, it would seem absurd to refer them both under one species. We have had little opportunity of studying this species otherwise than from dried specimens and can hardly express an opinion on this matter or on the relationship between these various forms and forms of *R. subfusca* (Woodward) Agardh.

Odonthalia Aleutica (Agardh) J. Agardh.

On rocks and algæ in the lower litoral and upper sublitoral zones. Unalaska, Alaska, *C. A. Agardh* (1820, pl. 5, under *Rhodomela Aleutica*); Shumagin Islands, Alaska, *Saunders* (1901, p. 438); St. Paul, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5150!; Victoria, B. C., *Tilden*, No. 315!, under *Rhodomela floccosa* form b); Esquimalt, B. C., *Tilden*, No. 314! under *Rhodomela floccosa*; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 16!, 92!

This species is probably not uncommon along our northwestern coast from the Strait of Juan de Fuca to Unalaska. It is probably often confused with the next, but it is to be distinguished from it by the fact that the tetrasporic and cystocarpic branches are not shortened or collected into a glomerule, but are in a loose raceme. It is to be distinguished from coarser forms of the last species by its distichous branchlets.

Odonthalia floccosa (Esper) Falkenberg.

Unalaska and Sitka, Alaska, *Postels and Ruprecht* (1840, p. 14); Sannak Island, Alaska, *Turner* (1886, p. 85); Popof Island, Kukak Bay, Yakutat Bay, Sitka, Wrangell, and Annette Island, Alaska, *Saunders* (1901, p. 448); Strait of Juan de Fuca and Point Roberts, B. C., *Harvey* (1862, p. 167).

There has been much confusion in the specimens referred to this species. Postels and Ruprecht (1840, p. 14) include the preceding species and *Fucus pilulifer* Turner, both of which seem to us distinct. It has been confused with forms of *Rhodomela Lycopodioides*, etc., until it is difficult to determine from the references whether they refer to the species as Falkenberg has defined it or not. We have, therefore, given the references above without comment. We have found three forms standing out fairly distinctly from the mass of forms, viz.—f. *typica*, f. *comosa*, and f. *macracantha*, and have noted them below.

Odonthalia floccosa f. typica Setchell and Gardner nom. nov.

The typical form is represented by Esper (1802, pl. 130) and rather better by Turner (1808, pl. 8), under the name of *Fucus floccosus*. The type came from Port Trinidad, California,

according to Turner, who sent Esper his specimens, although the latter represents them as having been brought from Nootka Sound, B. C., by Cook. They were collected by Menzies according to Turner. This form is a slender form of the more southern waters, and we have not seen any characteristic specimens of it from our territory. No. 313 of Tilden's American Algæ, from San Juan Island, Wash., may represent this form, but the specimen is not very complete. Kuetzing's figure of *Lophura floccosa* (1865, pl. 38, c–e) may be of this form, but it is transitional to f. *macracantha*. *Fucus pilulifer* of Turner (1819, pl. 236) seems to us not to be of this species, but probably a much battered plant of *O. Aleutica*. It was collected at Nootka Sound, B. C., by Menzies.

Odonthalia floccosa f. **comosa** Setchell and Gardner f. nov. PLATE 27.

A luxuriant form, near f. *typica*, but with the branchlets more numerous, longer, slender and recurved so as to give a compact, shaggy appearance to the whole plant. The collecting of the stichidia and cystocarpic branchlets into compact heads with involucre-like outer branchlets characteristic of the species, reaches its extreme in this form as may be seen from the figures on Plate 27. The distichous arrangement of the branchlets is to be seen plainly only at the very tip, and even there is often obscure, especially in dried specimens.

On exposed rocks in the litoral zone. Agattu Island, Alaska, *Townsend*, No. 5760!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3255!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4037!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5090!; Port Renfrew, B. C., *Butler and Polley*!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 29!, 96!

This form is sufficiently distinct in appearance to be told at a glance, but it is really only a more luxuriant form of the typical condition. It seems to be confused at times with *Rhodomela Larix*, but is distichous in its scheme of branchlets, less coarse and less rigid.

Odonthalia floccosa f. **macracantha** (Kuetzing) Setchell and Gardner comb. nov.

Lophura macracantha Kuetzing, Tabulæ Phycologicæ, Vol. 15, p. 14, pl. 39, d–g, 1865.

On rocks in the litoral zone. St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5796! (cf. Setchell, 1899, p. 594, under *Rhodomela floccosa*); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3254!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, Nos. 5083!, 5085!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5106!; Port Renfrew, B. C., *Butler and Polley*!

This is a coarser and laxer form than the preceding and is well represented by Kuetzing's figures. The glomerules of reproductive branchlets are distinct but not so dense as in f. *comosa*.

Odonthalia Lyallii (Harvey) J. Agardh. PLATE 27.

On different algæ, in the upper sublitoral zone. Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 168, under *Rhodomela Lyallii*); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 3!, 126!, 161!, 193!, and in Collins, Holden and Setchell, P. B.-A., No. 940!; San Juan Island, Wash., *Tilden*, No. 319!, under *Laurencia Grevilleana*.

We have had considerable trouble in determining with any certainty, or at least satisfaction, the Odonthalias of our coast, and the present arrangement, while it seems to us to represent the case fairly well from the species point of view, must necessarily be provisional as far as the exact synonymy is concerned. The plant included under this name, is, we feel quite certain, the plant of Harvey. Besides the locality of Whidbey Island, Gardner has found it also near Port Townsend. The latter locality must be in the same immediate region whence the type specimen was obtained. The species, as it comes ashore, is frequently long (up to 45 cm. and probably even longer), without trace of midrib, with the cystocarps alternating and distant on unchanged pinnules, while the stichidia are placed more closely, but the rhachis is not appreciably abbreviated. These are shown in the figures on plate 27. The only species which seems to come near it is the next, but in that, the frond has a distinct midrib and the

reproductive organs are more fasciculate. The cystocarps too, in the next species, are calcarate, while those of *O. Lyallii* are ecalcarate. We have found old and complete specimens of *O. Lyallii* with a thickened stipe-like portion below, but even here, there is little midrib and the upper portion is entirely plane. Miss Tilden's specimen from San Juan Island probably belongs to this species, but may perhaps, judging from its color, more properly be placed under the next. Certainly it has nothing in common with *Laurencia Grevilleana* under which she has placed it.

Odonthalia Kamtschatica (Ruprecht) J. Agardh.

St. Paul Island, Alaska, *Ruprecht* (1851, p. 214, under *Atomaria Kamtschatica*); Sannak Island, Alaska, *Turner* (1886, p. 85); Unga, Alaska, *A.A.L.*, No. 5051!; Kukak Bay and Yakutat Bay, Alaska, *Saunders* (1901, p. 438); Port Renfrew, B. C., *Butler and Polley*, No. 102!; Vancouver Island, B. C., and Port Angeles, Clallam County, Wash., *G. W. Lichtenthaler.*

We have quoted the various published mentions of the occurrence of this species within our territory and have added two localities whence we have examined specimens. We feel much doubt in referring the specimens to this species; one is a sterile plant and, while the other has stichidia, the chief differences between them and the specimens from Whidbey Island, which we refer fairly confidently to the preceding species, is in the color (these being a dark red and those being a light brownish tint) and a tendency on the part of the specimens we refer to the present species to have a fairly prominent midrib in the lower portion of the frond. The figure of *O. angustifolia* Postels and Ruprecht (1840, pl. 27), which Ruprecht says is of this species and not of *O. angustifolia* Suhr, shows a sterile plant with a distinct midrib to very near the tips of the branches.

Odonthalia semicostata (Mertens) J. Agardh. PLATES 26, 27.

On rocks in the upper sublitoral zone. Victoria, B. C., *Tilden*, No. 312!, under *Odonthalia dentata*; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 61!, 161a!, and in Collins, Holden, and Setchell, P. B.-A., No. 941!

A common species along the west coast of Whidbey Island and found cast ashore the year round. It seems to fruit about

the month of August, and bears both cystocarps and tetrasporangia in abundance. It approaches both *O. dentata* and *O. Kamtschatica.* From the former, it differs in having the branchlets dentiform to subulate and the cystocarps usually ecalcarate, while from the latter it differs in having the rhachis of the pinnule bearing either cystocarps or stichidia, abbreviated. Our plants differ from the description of J. G. Agardh (1863, p. 898) in being rather thicker in substance and darker in color. It is probable that many changes will be made in the names of the species of this genus when an opportunity is given for the study of our northwestern species in their habitats and a comparison with type specimens. Much confusion has already been produced, and one has only to compare the accounts of Ruprecht (1851) and J. G. Agardh (1863) to see how difficult it is likely to be to attempt to unravel completely the synonymy.

Odonthalia dentata (L.) Lyngbye.

Point Barrow, Alaska, *Farlow* (1885, p. 192); St. Lawrence Island, Alaska, *Kjellman* (1889, p. 24); Victoria, B. C., *Farlow* (1886, p. 470).

We have not seen any specimens referable to this species from our territory.

Odonthalia dentata f. angusta Harvey.

Arctic coast of Alaska, *Harvey* (1872, p. 463.)

Dasyopsis plumosa (Harvey and Bailey) Schmitz.

On wood and stones in the upper sublitoral zone. Puget Sound, *Harvey and Bailey* (1851, p. 371), *Bailey and Harvey*, (1862, p. 160), both under *Dasya (Stichocarpus) plumosa*; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 17!, 28!, 133!, and in Collins, Holden and Setchell, P. B.-A., No. 942!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 486!

A beautiful species, apparently not very common and occurring as far south as Monterey, California. We have examined both cystocarpic and tetrasporic plants from our territory.

FAMILY CERAMIACEÆ.

Griffithsia ——— ?

Two different sets of plants are known to us from our territory, but neither possess reproductive organs of any kind, and are, consequently, indeterminable. They are as follows: On rocks, Tracyton, Kitsap County, Wash., *Tilden*, No. 208!, under *G. opuntioides*, and on piles, Keyport, Kitsap County, Wash., *N.L.G.*, No. 495! We find a species on the coast of California, which has also been referred to *G. opuntioides*. The Californian specimens are usually sterile, but we have seen some with tetrasporangia, and although cystocarps and antheridia are needed to complete the diagnosis, it seems to be new, certainly not the species to which it has been referred.

Pleonosporium Vancouverianum J. Agardh.

On stones in the upper sublitoral zone. Vancouver Island, B. C., *J. G. Agardh* (1876, p. 30, under *Callithamnion Vancouverianum*); Esquimalt, B. C., *Harvey* (1862, p. 175, under *Callithamnion thuyoideum*, fide J. G. Agardh, 1876, p. 30); East Sound, Orcas Island, Wash., *N.L.G.*, No. 501!; Friday Harbor, San Juan Island, Wash, *N.L.G.*, No. 506!

We have not been able to examine an authentic or type specimen of this species, but the specimens referred here seem to agree well with the description. Our plants agree well with the figure of *Callithamnion venustissimum* in Kuetzing's Tabulæ Phycologicæ (1862, pl. 1) which J. G. Agardh quotes under this species with a query. The habit is certainly close. The procarps in No. 506 are terminal and No. 501 has tetrasporangia with the contents divided into many spores.

Callithamnion polyspermum Agardh.

On membranous algæ. Esquimalt, B. C., *Harvey* (1862, p. 175); Vancouver Island, B. C., *J. G. Agardh* (1876, p. 32); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 163!, 619!

The Whidbey Island specimens referred here are done so with doubt. They are not well developed plants, but seem to belong here.

Callithamnion Baileyi Harvey.

On a wooden float, etc. West coast of Whidbey Island, Wash., *N.L.G.*, No. 221!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 504!

The plants seem to agree in all respects with all the figures, descriptions, and published specimens of this species. They are to be distinguished from the last two by the tapering mucronate tips of the branchlets. The branchlets have elongated cells, thus differing from *C. tetragonum* (Withering) Agardh. Our specimens possess tetrasporangia.

Ceratothamnion Pikeanum f. **laxum** Setchell and Gardner f. nov.

On vertical rocks exposed to the force of the waves, often under a covering of overhanging Fucus, in the litoral zone. Shumagin Islands, Alaska, *Saunders* (1901, p. 439, under the species); Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5127!, and in Collins, Holden and Setchell, P. B.-A., No. 943!; Yakutat Bay and Sitka, Alaska, *Saunders* (1901, p. 439, under the species); Esquimalt, B. C., *Harvey*) 1862, p. 175, under *Callithamnion arbuscula* var. *Pacificum*); Vancouver Island, B. C., *J. G. Agardh* (1876, p. 37, under *Callithamnion arbuscula*); Brown Island, San Juan County, Wash., *Tilden*, No. 311!, under *Callithamnion arbuscula*; west coast of Whidbey Island, Wash., *N.L.G.*, No. 231!

Plant smaller and more bushy than the type, main and secondary axes less set off from one another, and the branchlets less dense and less closely applied to the branches. The type of this species, as represented in the type locality at the Golden Gate, San Francisco, is shown in No. 390 of Collins, Holden and Setchell, Phycotheca Boreali-Americana, and the f. *laxum* is shown in No. 943 of the same distribution. The differences in habit due to the differences in structure mentioned above bring about a very considerably different aspect in the two sets of plants.

Ptilota Asplenioides (Turner) Agardh.

On other algæ in the upper sublitoral zone. St. Paul Island, Alaska, *Ruprecht* (1851, p. 232), *Farlow, Anderson and Eaton*,

No. 82!, *Townsend*, No. 5784!, *Greeley and Snodgrass*, No. 5801!; Amaknak Island and Unalaska Island, Alaska, *Postels and Ruprecht* (1840, p. 15); Bay of Morozof (Morzhovoi Bay), Alaska, *Townsend*, No. 5775!; Sannak Island, Alaska, *Turner* (1886, p. 85); Unga, Alaska, *A.A.L.*, No. 5046!; Prince William Sound, Alaska, *Turner* (1808, p. 139, pl. 62, under *Fucus Asplenioides*), *Esper* (1804, p. 78, pl. 147, under *Fucus Asplenioides*), *Postels and Ruprecht* (1840, p. 15), *Saunders* (1901, p. 439); Yakutat Bay, Alaska, *Saunders* (1901, p. 439), *Rev. Albin Johnson*, No. 5699!, and in Collins, Holden and Setchell, P. B.-A., No. 999!; Norfolk Sound (near Sitka), Alaska, *Postels and Ruprecht* (1840, p. 15); Puget Sound, *Bailey and Harvey* (1862, p. 163).

A coarse species easily recognized, confined to the northwest coast of North America and the northeast coast of Asia.

Ptilota Californica Harvey.

Cast ashore. Esquimalt, B. C., *Harvey* (1862, p. 175); Port Renfrew, B. C., *Tilden*, No. 307!, under *Ptilota serrata*.

Coarser forms of this may be taken for the preceding, but an examination shows that the pinnules are not at all decurrent. Miss Tilden's specimen is small and imperfect, but seems undoubtedly to belong to this species. Mr. Collins has reported a specimen from Port Renfrew, B. C. (Butler and Polley, No. 90) as being intermediate between this species and *Ptilota Hypnoides* Harvey.

Ptilota filicina J. Agardh.

On rocks in the upper sublitoral zone. St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5804a!; Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 16, under *Ptilota plumosa*); near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4099!; Kyska Island, Alaska, *Townsend*, No. 5767!; Sannak Island, Alaska, *Turner* (1886, p. 85, under *Ptilota plumosa* var. *filicina*); Shumagin Islands, Alaska, *Saunders* (1901, p. 16, under *Ptilota plumosa*); Unga, Alaska, *A. A. L.*, Nos. 5045!, 5046a!; Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5062!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5113!; Sitka, Alaska, *Postels and Ruprecht* (1840, p. 16), *Saunders* (1901, p.

439, under *Ptilota plumosa*); Vancouver Island, B. C., *J. G. Agardh* (1876, p. 76); Port Renfrew, B. C., *Butler and Polley*, No. 91; Brown Island, San Juan County, Wash., *Tilden*, No. 306!, under *Ptilota plumosa*; west coast of Whidbey Island, Wash., *N.L.G.*, No. 1!

When typical, this species is not difficult to determine by the fact that the opposite pinnules may differ in size and development, but not otherwise, and are corticated to the very tip. In practice, however, it is, at times, somewhat uncertain as to whether a given specimen belongs to this species or to the next. We have taken it somewhat for granted that the plants from our territory referred to *Ptilota plumosa* really belong to this species, since we have been unable to find any of the former among the specimens we have been able to examine.

Ptilota pectinata (Gunner) Kjellman.

On rocks in the lower litoral and upper sublitoral zones. St. Lawrence Island, Alaska, *Kjellman* (1889, p. 32); St. Paul Island, Alaska, *Townsend*, No. 5783!, *Greeley and Snodgrass*, Nos. 5804b!, 5809!; Agattu Island, Alaska, *Townsend*, No. 5765!; Shumagin Islands, Alaska, *Saunders* (1901, p. 439, under *Ptilota serrata*); San Juan Island, Wash., *N.L.G.*, No. 218!

In this species, which is, at times, very difficult to make certain of, the opposite pinnules are different, one being pinnately branched while the other remains simple and only serrate.

Antithamnion floccosum f. Pacificum (Harvey) Setchell and Gardner comb. nov.

Most commonly on the stipes of Nereocystis, sometimes on other algæ and on wood, in the upper sublitoral zone. Yakutat Bay and Lowe Inlet, Alaska, and in Puget Sound, *Saunders* (1901, p. 439, under *Callithamnion floccosum Pacificum*); Esquimalt, B. C., *Harvey* (1862, p. 176, under *Callithamnion floccosum* var. *Pacificum*), *N.L.G.*, No. 325!; Port Renfrew, B. C., *Butler and Polley*, No. 21!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 620!; Orcas Island, Wash., *Harvey* (1862, p. 176, under *Callithamnion floccosum* var. *Pacificum*); Friday Harbor, San Juan Island, Wash., *Tilden*, No. 309!, under *Callithamnion*

floccosum var. *Pacificum*; Pleasant Beach, Kitsap County, Wash., *N.L.G.*, No. 346!

This form, which is abundant on the western coast of North America, grows in dense tufted masses. It is to be recognized by its long, simple, subulate branchlets.

Antithamnion Americanum (Harvey) Kjellman.

On stems of Nereocystis and on wood, in the upper sublitoral zone. Esquimalt, B. C., *Harvey* (1862, p. 175, under *Callithamnion Americanum*); Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 502!

The specimen from San Juan Island is referred here with some doubt. The tetrasporangia are secund on the branchlets, but they are also provided with a unicellular pedicel.

Antithamnion Pylaisæi (Montagne) Kjellman.

On Nereocystis and on wood, upper sublitoral zone. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 72!, 447!, 453!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 503!

The specimens referred here have a more verticillate habit than the last, and are more slender than the next. They seem to be distinguished better by habit than by any microscopical character.

Antithamnion Pylaisæi f. Norvegica Kjellman.

Floating. Ludlow Bay, Jefferson County, Wash., *N.L.G.*, No. 438!

Agrees well with Kjellman's figure (1883, pl. 16, f. 1).

Antithamnion subulatum (Harvey) J. Agardh.

On larger algæ. Esquimalt, B. C., *Harvey* (1862, p. 175, under *Callithamnion subulatum*); Port Renfrew, B. C., *Butler and Polley*, No. 40, and in Collins, Holden and Setchell, P. B.-A., No. 944!; Vancouver Island, B. C., *G. W. Lichtenthaler* (in Herb. F. S. Collins); west coast of Whidbey Island, Wash., *N.L.G.*, No. 922!

A coarser species than the preceding and with the pinnules provided with short subulate lateral branches. The type seems to have disappeared, since Professor W. G. Farlow has searched

for it both at Dublin and at London without success. The determination of the P. B.-A. specimen is by Farlow and Collins and may be accepted for the present as representing the species. The specimen distributed by Miss Tilden under the name *Callithamnion subulatum* (No. 310) is an entirely different plant and will be noted under *Platythamnion heteromorphum*. We append a note kindly furnished us by Mr. F. S. Collins.

"It is doubtful if there are any authentic specimens in existence of Harvey's *Callithamnion subulatum*; Prof. Farlow states that he looked for the specimens in Harvey's herbarium at Dublin, but without success; the specimens now in question are referred to this species from the general agreement with the diagnosis given by Harvey (Proc. Linn. Soc., Bot., Vol. VI, p. 175). While Harvey compares the plant with *C. Americanum* Harv., it seems to be nearer to *Antithamnion Pylaisæi* (Mont.) Kjellman. *A. Americanum* has long, slender, loose ramuli, *A. Pylaisæi* more dense, short and stout, while *A. subulatum*, as here understood, carries these characters to a still greater degree. The articulations are shorter, seldom over three diameters in the main branches, while in the lesser ramuli the cells are often broader than long. Every ramulus tapers from the base to the very acute tip, while in *A. Pylaisæi* the tapering is manifest only near the end, and the terminal cell is not very acute; in New England specimens not so acute as in Harvey's figure (Nereis Bor.-Am., Pl. XXXVI B). The main branches are less divided in *A. subulatum* than in *A. Americanum* or *A. Pylaisæi*, resembling rather some forms of *A. floccosum*. The tetraspores in the Vancouver specimens are usually cruciate, but sometimes rather irregular, and might at a hasty glance be taken for tripartite, as described by Harvey. While the species is evidently nearly related to *A. Pylaisæi*, *A. floccosum* and *A. Americanum*, it is as distinct from them as they are from each other; and the specimens examined, nearly one hundred in number, are quite uniform."

Antithamnion Plumula (Ellis) J. Agardh.

Saunders (1901, p. 439) says that this species was collected by him several times in Puget Sound, but was not seen in Alaskan

waters. He also says that it is a comparatively common plant in Puget Sound, while on the central Californian coast it is rarely found. We have not seen any specimens referable to the genuine *A. Plumula* from any portion of the western coast of North America.

Antithamnion boreale f. typica Kjellman.

On rocks and wood in the litoral zone. Port Clarence and St. Lawrence Island, Alaska, *Kjellman* (1901, p. 33); Cape Denbigh, Norton Sound, Alaska, *R. C. McGregor*, No. 5661!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 490!

This form runs into the next and it is often difficult to determine to which form a given plant is to be referred.

Antithamnion boreale f. corallina Kjellman.

On rocks in the middle and lower litoral zones. Besboro Island, Norton Sound, Alaska, *R. C. McGregor*, No. 5662!; Cormorant Rocks, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5135!; Sitka and Wrangell, Alaska, *Saunders* (1901, p. 349, under *Antithamnion boreale*).

Saunders's specimens are placed here because he says that they are very close to this form. All the species of Antithamnion seem to be connected by intermediate forms from the simplest forms of *A. boreale* up to the most complex forms of *A. Pylaisæi* or *A. subulatum*. We may well believe with Kjellman (1883, p. 181) that "the genus *Antithamnion* is a young genus whose species are in course of development, no marked differentiation being as yet established and the transitional forms not having disappeared."

Platythamnion heteromorphum f. **typicum** Setchell and Gardner comb. nov.

Cast ashore. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 164!, 408!; Friday Harbor, San Juan Island, Wash., *Tilden*, No. 310!, under *Callithamnion subulatum*.

The plants referred here seem to agree well with the descriptions of J. G. Agardh (1876, p. 23, and 1892, pp. 22, 23.) The pinnules have branchlets distichous and on both sides below, but secund and on the upper side, above.

Platythamnion heteromorphum f. **reversum** Setchell and Gardner f. nov. PLATE 25.

Cast ashore. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 8!, 621!

This form differs from the last in the branchlets of the upper pinnules being secund and on the lower side, as shown in the figure quoted above. It may be only a casual variation, but it deserves at least a form-name and more study in its native waters.

Ceramium rubrum (Hudson) Agardh.

Bering Sea, Herb. *University of California* (2 specimens without name of collector, but date of 1892); St. Lawrence Island and Port Clarence. Alaska, *Kjellman* (1889, p. 32); Prince William Sound and Sitka, Alaska, *Saunders* (1901, p. 439); Esquimalt, B. C., *Harvey* (1862, p. 175); Vancouver Island, B. C., *J. G. Agardh* (1894, p. 38); Puget Sound, *Bailey and Harvey* (1862, p. 163).

We quote under this name the specimens referred here by others and which we have not been able to examine. We feel certain that a careful study will show that more than one species, in the later sense of J. G. Agardh (1894, under Ceramium), has been included. We do not feel at all certain that the Bering Sea specimens are *C. rubrum* in the narrower sense.

Ceramium rubrum var. **Pacificum** Collins.

Port Renfrew, B. C., *Butler and Polley*, No. 30; west coast of Whidbey Island, Wash., *N.L.G.*, No. 117!; Traeyton, Kitsap County, Wash., *Tilden*, No. 207!, under *Ceramium diaphanum*.

The plant referred here is common on the western coasts of North America from Puget Sound to Lower California, but the name is merely provisional since it may be referred later under some other of the *C. rubrum*-group. The specimen of Miss Tilden's American Algæ is a fragment, but seems to belong here, certainly not under *Ceramium diaphanum* (Lightfoot) Agardh.

Ceramium cancellatum Agardh.

Esquimalt, B. C., *Harvey* (1862, p. 175).

Unknown to us.

Ceramium codicola J. Agardh.

On *Codium mucronatum* f. *Californicum*. Sitka, Alaska, *Saunders* (1901, p. 439); Ludlow Bay, Jefferson County, Wash., *N.L.G.*, No. 439!

The specimens collected at Ludlow Bay are well developed and have both cystocarps and tetrasporangia.

Ceramium tenuissimum (Lyngbye) J. Agardh.

On sticks and stones in brackish or muddy water, upper sublitoral zone. Esquimalt, B. C., *Harvey* (1862, p. 175); Whidbey Island, Wash., *N.L.G.*, No. 236!

We are indebted to Mr. F. S. Collins for the determination of the plant from Whidbey Island.

Ceramium Californicum J. Agardh.

On algæ in the upper sublitoral zone. Esquimalt and Point Roberts, B. C., *Harvey* (1862, p. 175, under *Ceramium diaphanum*); west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 617!, 617a!, 618!

We have not seen Harvey's plants, but refer them here because the rest of the west coast *C. diaphanum* has been placed under this species. The Whidbey Island specimens are typical and show cystocarps, tetrasporangia, and antheridia.

Microcladia borealis Ruprecht.

On rocks in the litoral zone. Unalaska, Alaska, *Ruprecht* (1851, p. 259): "Pinnacles," Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5004!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3256!; "Una Nootka" and Fort Vancouver, B. C., *Harvey* (1852, p. 210); Strait of Juan de Fuca, B. C., *Harvey* (1862, p. 175); Puget Sound, *Saunders* (1901, p. 449); Port Renfrew, B. C., *Butler and Polley*, No. 18; west coast of Whidbey Island, Wash., *N.L.G.*, No. 172a!; Friday Harbor, San Juan Island, Wash., *N.L.G.*, No. 222!

This species is fairly common on the shores of the Bay of Unalaska, but was not found, nor is it reported, from any of the shores until the region of Puget Sound is reached. It is common along the coast of Oregon and on that of California down to the neighborhood of Point Conception.

Microcladia Californica Farlow.

Port Renfrew, B. C., *Butler and Polley*, No. 35.

The determination is by Mr. F. S. Collins and the specimen is preserved in his herbarium.

Microcladia Coulteri Harvey.

On algæ in the upper sublitoral zone. Esquimalt, B. C., *Harvey* (1862, p. 175); Port Renfrew, B. C., *Butler and Polley*, No. 37; Strait of Juan de Fuca, *G. W. Lichtenthaler;* west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 26!, 37!, 99!

The plants from Whidbey Island have good involucrate cystocarps and consequently belong here. Miss Tilden has distributed a specimen (No. 206!) from Tracyton, Kitsap County, Wash., which probably belongs here, but the specimen is fragmentary and sterile and may belong to the preceding species.

Rhodochorton Rothii (Turton) Naegeli.

On rocks in the litoral zone. St. Michael, Alaska, *W.A.S.*, Nos. 5244x!, 5153x!; Prince William Sound, Alaska, *Saunders* (1901, p. 440); Victoria, B. C., *N.L.G.*, No. 330!; Hog Island, near LaConner, Skagit County, Wash., *N.L.G.*, No. 307!

Some of the specimens bear tetrasporangia, notably No. 5244x.

Rhodochorton subimmersum Setchell and Gardner sp. nov.

PLATE 17.

Prostrate filaments immersed in the cortex of the host plant, giving rise to simple erect filaments which project above the surface of the host, and bear the tetrasporangia at the tips. Tetrasporangia one or two at the tip of an erect filament, cruciately divided.

Forming irregular patches in the frond of *Grateloupia Cutleriæ*. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 289!, 289a!

This minute, somewhat immersed species differs from anything that has been described, unless it be *Callithamnion humile* Kuetzing, figured in the Tabulæ Phycologicæ (Vol. 11 pl. 58, I). A careful comparison with the original will be necessary to determine whether they are the same or not.

FAMILY GLOIOSIPHONIACEÆ.

Gloiopeltis furcata (P. & R.) J. Agardh.

On rocks in the litoral zone. North Pacific Ocean, *Postels and Ruprecht* (1840, p. 19, under *Dumontia furcata*); Shumagin Islands, Alaska, *Saunders* (1901, p. 440); Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5089!; Yakutat Bay, Sitka, and Annette Island, Alaska, *Saunders* (1901, p. 440); Port Renfrew, B. C., *Butler and Polley*, No. 28!, and in Collins, Holden and Setchell, P. B.-A., No. 945b!; Brown Island, San Juan County, Wash., *Tilden*, No. 305!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 198!, and in Collins, Holden and Setchell, P. B.-A., No. 945a!; San Juan Island, Wash., *N.L.G.*, No. 198a!

Gloiosiphonia Californica (Farlow) J. Agardh.

On rocks and on wood in the upper sublitoral zone, and even in tide pools in the litoral zone. Prince William Sound, Alaska, *Saunders* (1901, p. 440); Esquimalt, B. C., *W.A.S.*, No. 1869!; Port Angeles, Clallam County, Wash., *G. W. Lichtenthaler*; Pleasant Beach, Kitsap County, Wash., *N.L.G.*, No. 343!

This plant was first described by Farlow under Nemastoma, (1877, p. 243), later referred to Gloiosiphonia by J. G. Agardh (1884, p. 10), and still later to Calosiphonia (1899, p. 83). Probably to be included under this species are *Halymenia ligulata* Harvey (1862, p. 173) and *Gloiosiphonia capillaris* Harvey (1862, p. 174), from Esquimalt, B. C.

Gloiosiphonia verticillaris Farlow.

On stones in the upper sublitoral zone. Port Renfrew, B. C., *Tilden*, No. 205!; near Port Townsend, Wash., *N.L.G.*!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 169!

Apparently a very rare species in the region of Puget Sound. It occurs also on the coast of California, but unless it is detected at the period of growth (spring), it might be searched for in vain.

Family Grateloupiaceæ.

Æodes nitidissima J. Agardh.

Cast ashore, probably growing in the sublitoral zone at a depth of several fathoms. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 152!, 487!, and in Collins, Holden and Setchell, P. B.-A., No. 946!

The discovery of this New Zealand species on the coast of California has been announced by one of us (cf. Setchell, 1901, p. 126) and now we have the opportunity of recording its occurrence in the region of Puget Sound. The specimens distributed show both cystocarps and tetrasporangia and agree in habit and structure with an authentic specimen distributed by J. G. Agardh. The shiny appearance of the surface of the frond which is responsible for the specific name seems to depend upon age and circumstances of preparation of the specimen, being very pronounced in some specimens and absolutely lacking in others.

Grateloupia Cutleriæ (Binder) J. Agardh.

Cast ashore from the upper sublitoral zone. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 98!, 135!, 148!, 191!

The specimens from Whidbey Island are all large and more or less pinnate, and agree well with the figures of this species in Kuetzing's Tabulæ Phycologicæ (pl. 35, 36, and 37, especially with the last). Some of the specimens have the "pinnæ" large and again once or twice pinnate. Both cystocarpic and tetrasporic plants have been found. Older forms are to be distinguished from some forms of *Prionitis Lyallii* chiefly by their softer texture.

Grateloupia pinnata (P. & R.) Setchell.

On rocks in the upper litoral zone. Norfolk Sound (near Sitka), Alaska, *Postels and Ruprecht* (1840, p. 18, under *Iridæa pinnata*); Port Renfrew, B. C., *Butler and Polley*, No. 87, and in Collins, Holden and Setchell, P. B.-A., No. 947!; Tracyton, Kitsap County, Wash., *Tilden*, No. 222!, under *Gigartina microphylla*.

The specimens included under this name, other than the type, have been compared with an authentic specimen in Herb. Farlow by F. S. Collins, who reports that they are of the same general habit as the Ruprecht specimens, but that the latter are coarser. We feel that it is reasonably safe to quote them under this species, since there is no doubt but that the *Iridæa pinnata* P. & R. is a Grateloupia, with Norfolk Sound in the region of Sitka, Alaska, for the type locality. Miss Tilden's specimen is young, but seems certainly to belong here and has nothing in common with *Gigartina microphylla* Harvey. The specimens collected at Port Renfrew have both cystocarps and tetrasporangia. This species has nothing to do with *Grateloupia pinnata* (Hooker and Harvey) J. Agardh, which, if retained in this genus, may, if we follow priority, need a new specific name.

Prionitis Lyallii Harvey.

We have had the opportunity of examining the cotypes of several of the forms of this species in Herb. Farlow and of comparing these with considerable material collected on the coasts of Puget Sound and of California. We have come to the conclusion that there exist at least four well marked species on the western coast of North America, viz.: *P. Lyalli* Harvey, *P. lanceolata* Harvey, *P. angusta* (Harvey) Setchell, and *P. decipiens* (Montagne) J. Agardh. These have been distributed as follows:—

P. Lyallii f. *normalis*—Collins, Holden and Setchell, P. B.-A., No. 448!, Farlow, Anderson and Eaton, Alg. Exsicc. Am. Bor., No. 24!; *P. Lyallii* f. *gladiata*—Collins, Holden and Setchell, P. B.-A., No. XXV!; *P. lanceolata*—Farlow, Anderson and Eaton, Alg. Exsicc. Am. Bor., No. 81a!, Collins, Holden and Setchell, P. B.-A., No. 199a!; *P. angusta*—Farlow, Anderson and Eaton, Alg. Exsicc. Am. Bor., No. 81B!, Collins, Holden and Setchell, P. B.-A., No. XXIV!; *P. decipiens*—Collins, Holden and Setchell, P. B.-A., No. 199b!

Prionitis Lyallii is to be distinguished by having its branches and branchlets decidedly contracted at the base and more or less gladiate. It approaches *P. lanceolata* too closely at times. Harvey has separated the various forms under a number of form-names which are given below. They pass into one another by insensible gradations.

Prionitis Lyallii f. lanceolata Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 173).

Prionitis Lyallii f. ornata Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 173); west coast of Whidbey Island, Wash., *N. L. G.*, No. 638!, and in Collins, Holden and Setchell, P. B.-A., No. 949!

The specimen distributed corresponds fairly well to the description of Harvey, except that it is much more branched and of firmer texture. Miss Tilden has distributed a scrap under No. 204 of her American Algæ which may belong here. It came from Port Orchard, Kitsap County, Wash.

Prionitis Lyallii f. normalis Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 173): Penn's Cove, near Coupeville, east coast of Whidbey Island, Wash., *N. L. G.*, No. 65!; near Seattle, Wash., *Tilden*, No. 302!, under *Farlowia compressa*.

We have been able to examine a cotype of this form in Herb. Farlow and can refer the specimens quoted above with confidence.

Prionitis Lyallii f. gladiata Setchell.

Port Renfrew, B. C., *Butler and Polley*, No. 75.

Prionitis Lyallii f. densissima Harvey.

On rocks in tide pools, upper litoral zone. Esquimalt, B. C., *Harvey*! (1862, p. 174). *N. L. G.*, No. 639!, and in Collins, Holden and Setchell, P. B.-A., No. 948!; Port Renfrew, B. C., *Butler and Polley*, No. 119!; Fairhaven, Wash., *N. L. G.*, No. 78!; Whidbey Island, Wash., *N. L. G.*!; San Juan Island, Wash., *Tilden*, No. 303!, under *Prionitis lanceolata*.

These plants agree well with a specimen from Harvey in Herb. Farlow.

Prionitis Lyallii f. intermedia Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 174).

Prionitis Lyallii f. dilatata Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 174).

Prionitis Lyallii f. depauperata Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 174).

Prionitis lanceolata Harvey.

Puget Sound, *Bailey and Harvey* (1862, p. 162).

We have never seen a specimen of undoubted *P. lanceolata* from our territory.

Prionitis lanceolata? var. filicina Harvey.

Esquimalt, B. C., *Harvey* (1862, p. 174).

Prionitis jubata J. Agardh.

Sitka, Alaska, "Ex. Herb. *Acad. Petrop.*" in Herb. Farlow!, under *Gelidium crassifolium*.

Two specimens are preserved in Herb. Farlow, having come from the Herbarium of the St. Petersburg Academy and bearing the name of *Gelidium crassifolium*. This is the name, credited to Postels and Ruprecht, given by J. G. Agardh (1876, p. 160) under his *Prionitis jubata*. The plants seem to belong to a dwarf form of *Prionitis lanceolata*, but not certainly so.

Cryptonemia obovata J. Agardh.

Attached to pebbles in the upper sublitoral zone. Prince William Sound, Alaska and in Puget Sound, *Saunders* (1901, p. 440).

FAMILY DUMONTIACEÆ.

Dumontia filiformis (Lyngbye) J. Agardh.

On stones in the middle litoral zone. Port Clarence, Alaska, *Kjellman* (1889, p. 30); east shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3277!; west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 5001!; Shumagin Islands, Kukak Bay, Cook Inlet, and Prince William Sound, Alaska, *Saunders* (1901, p. 440).

From what Kjellman says (1889, p. 30), it seems that there may be reasons for separating the plant of the North Pacific from that of the North Atlantic. We have had little opportunity for examining the plant of the latter region, while the plants of the

North Pacific accessible to us are all tetrasporic. Concerning the synonymy and adoption of the name, we have followed the general usage according to J. G. Agardh (1876, p. 257) even after a careful consideration of the elaborate discussion of Ruprecht (1851, pp. 295–308, under *D. contorta*). Most of the species placed under Dumontia by Postels and Ruprecht are to be referred to Halosaccion or Gloiopeltis, while *D. Clara* and *D. coronata* are, according to Ruprecht (1851, p. 286), of animal rather than of plant nature, although the latter has been referred to as possibly being a *Chætangium*.

Cryptosiphonia Woodii J. Agardh.

On rocks more or less exposed to the waves, in the litoral zone. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3267!: near Iliuliuk, Unalaska, Alaska, *W.A.S and A.A.L.*, Nos. 4039!, 5010!; Sitka, Alaska, *W.A.S. and A.A.L.*, No. 5207!; Vancouver Island, B. C., *J. G. Agardh* (1870, p. 15, under *Pikea Woodii*); west coast of Whidbey Island, Wash., *N.L.G.*, No. 5!

It seems that the more densely branched, bushy species which does not collapse when removed from the water, is *Cryptosiphonia Woodii* and not the slender plant which collapses. The latter has passed among Californian algologists under this name, however, and has been distributed by one of us (in Collins, Holden and Setchell, P. B.-A., No. 449!) under it, but is really to be placed under the next species. It may be doubted whether the two species (as now recognized) represent more than divergent forms of one rather varied species!

Cryptosiphonia Grayana J. Agardh.

On rocks in the litoral zone. Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5126!; Kukak Bay, Alaska, *Saunders* (1901, p. 441); Orca, Alaska, *W.A.S. and A.A.L.*, No. 5160!; Yakutat Bay, Sitka, and Wrangell, Alaska, *Saunders* (1901, p. 441); Vancouver Island, B. C., *J. G. Agardh* (1870, p. 15, under *Pikea Grayana*); west coast of Whidbey Island, Wash., *N.L.G.*, No. 5a!

Farlowia mollis (Harvey and Bailey) Farlow and Setchell.

On rocks in the upper part of the sublitoral zone. Puget Sound, *Harvey and Bailey* (1851, p. 372), *Bailey and Harvey* (1862, p. 163, pl. 6, f. 3, 4), both under *Gigartina mollis*; Strait of Juan de Fuca, *Harvey* (1862, p. 173, under *Gigartina mollis*); Port Renfrew, B. C., *Butler and Polley*, Nos. 86!, 122!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 113!, 214!, 239!

As stated under No. 898 of Collins, Holden and Setchell, P. B.-A., the plant named *Gigartina mollis* by Harvey and Bailey is really a Farlowia and closely related to, perhaps identical with, *Farlowia compressa* J. Agardh. It is, however, a smaller, thinner, usually more pinnate plant than the type of that species. Californian specimens have been distributed under the number of the P. B.-A. quoted above.

Sarcophyllis arctica Kjellman.

On rocks in tide pools in the litoral zone and in the upper sublitoral zone. Port Clarence, Alaska, *Kjellman* (1889, p. 28); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 3243!, 5042!; near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4072!; Shumagin Islands, Alaska, *Saunders* (1901, p. 441, under *Dilsea arctica*); Unga, Alaska, *A.A.L.*, No. 5053!; Karluk, Kadiak Island, Alaska, *W.A.S.*, No. 5067!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5079a!

We prefer to retain the generic name Sarcophyllis for this genus, in preference to the name Dilsea, since for some twenty-five or more years it has been used, and the name Dilsea, doubtful and resurrected only recently from oblivion, has no rights from usage.

Sarcophyllis Californica J. Agardh.

On rocks in the upper sublitoral zone. Unga, Alaska, *J. B. Downing*, No. 5786!; Orca, Alaska, *Saunders*, No. 313!, (1901, p. 441, under *Dilsea Californica*); Port Renfrew, B. C., *Butler and Polley*, Nos. 71!, 80!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 274!, 283!; San Juan Island, Wash., *Tilden*, No. 323!, under *Turnerella Mertensiana*.

Whether all the plants placed under this name are to be included in one species may perhaps be doubted. Nevertheless, it is our experience with this species on the coast of California, that it varies much in size, color, shape and thickness, according to the season, age,.and exposure. The specimen of Miss Tilden is a large fragment with good cystocarpic fruit, which is clearly that of Sarcophyllis.

Sarcophyllis pygmaea Setchell comb. nov. PLATE 19.

Port Renfrew, B. C., *Butler and Polley*, No. 46!

The specimens of Misses Butler and Polley agree well with the specimens of this species issued by one of us in Collins, Holden and Setchell, P. B.-A., No. 396, under *Sarcophyllis Californica* f. *pygmaea*, and described later under the name of *Dilsea pygmaea* (cf. Setchell, 1901, p. 126). Very little of the horizontal thallus appears in the specimens, but in every other respect the agreement is perfect.

Constantinea rosa-marina (Gmelin) P. & R.

On stones and shells in the lower litoral and sublitoral zones, most commonly collected when cast ashore. St. Paul Island, Alaska, *Ruprecht* (1851, pp. 232, 262), Herb. *D. C. Eaton*!; near Iliuliuk, Unalaska, Alaska, *W. A. S. and A. A. L.*, Nos. 4082!, 4086!; Unga, Alaska, *A. A. L.*, No. 5049a!; Uyak Bay, Kadiak Island, Alaska, *W. A. S. and A. A. L.*, No. 5092!; Prince William Sound, Alaska, *Saunders*, No. 298! (1901, p. 441).

Various opinions have been held as to whether this plant is to be considered as being distinct from the next or not. From the materials at present accessible to us, we hold that it is to be distinguished from the next by the manner of the origin of the new blades. In this species, as far as we can judge from the figure of Gmelin (1768, pl. 5, f. 2 and 2a) the new blade appears first as a rosulate or saucer-shaped, nearly sessile structure, and this is farther shown in the description and plate of Postels and Ruprecht (1840, p. 17, pl. 30). In the next species, as shown in plate 18, figure 18, the first appearance of the new proliferation is in the form of a subulate structure which grows to some considerable length before the blade proper makes its appearance.

In *Constantinea simplex* Setchell (1901, p. 127), the proliferation is also rosulate (cf. Plate 18, f. 19–21). *C. rosa-marina* is not so ample a plant as the next, but this may not hold when more material is available for comparison.

Constantinea Sitchensis P. & R. PLATE 18.

On rocks in the upper sublitoral zone, frequently cast ashore in considerable quantity. Sitka, Alaska, *Postels and Ruprecht* (1840, p. 17); Victoria, B. C., *Harvey* (1862, p. 172); Esquimalt, B. C., *Tilden*, No. 203!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 94!, 685!; Mats-Mats Bay, Jefferson County, Wash., *N.L.G.*, in Collins, Holden and Setchell, P. B.-A., No. 950!; San Juan Island, Wash., *N.L.G.*!

We feel very certain of all the plants referred to this species, but feel, also, that we may have referred some of this species to the preceding, particularly the plant from Prince William Sound. E. M. Freeman (1899a) has given a very formal account of the structure of this species (under the name of *Constantinea rosa-marina*) but has neglected to treat of the most important point, viz.: the method of proliferation.

FAMILY NEMASTOMACEÆ.

Schizymenia Dubyi J. Agardh.

Esquimalt, B. C., *Harvey* (1862, p. 174).

We know nothing of this plant, but suspect that we may have included it under *Sarcophyllis Californica*.

Schizymenia coccinea Harvey.

In 14 fathoms. Griffin Bay, San Juan Island, Wash., *Harvey* (1862, p. 174).

We have been able to examine a small fragment of the type preserved in Herb. Farlow, and while we cannot be certain, we think that it is the same as the plant we have placed under *Æodes nitidissima*.

Family SQUAMARIACEÆ.

Petrocelis Middendorfii (Ruprecht) Kjellman.

Forming a close covering on rocks in the upper litoral zone. Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5124!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 74!, 262!, 488!

Our plants are all sterile, but have the pronounced basal portion, branching, etc., characteristic of this species.

Cruoria Pacifica Kjellman.

On stones and mussel shells, in the upper sublitoral zone. Port Clarence, Alaska, *Kjellman* (1889, p. 26).

Family CORALLINACEÆ.

The crustaceous forms have all been submitted to M. Foslie, of Trondheim, Norway, who has determined them and examined and approved the following account of the species (under the first four genera).

Clathromorphum circumscriptum (Strœmfelt) Foslie.

On stones in tide pools in the litoral and sublitoral zones. Port Clarence, Alaska, *Kjellman*, (1889, p. 22, under *Lithothamnion durum*); near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 4022!, 4081a!; Kukak Bay and Sitka, Alaska, *Saunders* (1901, p. 442).

Clathromorphum compactum (Kjellman) Foslie.

On mussel shells, lower litoral zone. St. Michael, Alaska, *W.A.S.*, No. 5156y!; Prince William Sound, Alaska, *Saunders* (1901, p. 422, under *Lithothamnion compactum*).

Clathromorphum loculosum (Kjellman) Foslie.

St. Lawrence Island, Alaska, *Kjellman* (1889, p. 21, under *Lithothamnion loculosum*).

Lithothamnion glaciale Kjellman.

In the upper elitoral and lower sublitoral zones. Shumagin Islands, Kukak Bay, and Prince William Sound, Alaska, *Saunders* (1901, p. 442).

Lithothamnion glaciale f. —— Foslie.

West coast of Whidbey Island, Wash., *N.L.G.*, No. 134!

Lithothamnion Sonderi f. Pacifica Foslie.

On rocks, upper sublitoral zone. Channel Rocks, near Seattle, Wash., *N.L.G.*, No. 654!

Lithothamnion phymatodeum Foslie.

West coast of Whidbey Island, Wash., *N.L.G.*, No. 653!

Lithothamnion læve (Strœmfelt) Foslie.

On rocks in the sublitoral zone. Kukak Bay, Alaska, *Saunders* (1901, p. 442).

Lithothamnion læve f. tenue (Kjellman) Foslie.

On mussel shells in the upper sublitoral zone. Port Clarence, Alaska, Kjellman (1889, p. 22, under *Lithophyllum tenue*).

Lithothamnion Californicum Foslie.

Upper sublitoral zone. Port Renfrew, B. C., *Yendo*; Channel Rocks, near Seattle, Wash., *N.L.G.*, No. 654! (in part).

Lithothamnion conchatum Setchell and Foslie.

On Amphiroa. Port Renfrew, B. C., *Yendo* (Foslie, 1902, p. 6); west coast of Whidbey Island, Wash., *N.L.G.*, No. 83a!

Probably "*Melobesia patens*" of Saunders (1901, p. 441) from Prince William Sound, on Amphiroa, belongs here.

Lithophyllum tumidulum Foslie.

On *Ahnfeldtia concinna*. West coast of Whidbey Island, Wash., *N.L.G.*, No. 658!

Lithophyllum (Eulithophyllum) incrustans f. orbicularis Foslie.

Port Renfrew, B.C., *Yendo*.

Lithophyllum (Lepidomorphum) Farlowii Foslie.

Sitka, Alaska, *Saunders* (1901, p. 442).

Lithophyllum Farlowii f.? Foslie.

On limpet shells. West coast of Whidbey Island, Wash., *N.L.G.*, No. 657!

Lithophyllum sp. nov. Foslie.

On limpet shells. West coast of Whidbey Island, Wash., *N.L.G.*, Nos. 655!, 656!

Lithophyllum (Lepidomorphum) Yendoi Foslie.

On rocks in the sublitoral zone. Sitka, Alaska, *Saunders* (1901, p. 442).

Foslie remarks (1901, p. 13) that it is a question whether *L. Yendoi* and *L. decipiens* must not be considered as forms of one and the same species.

Melobesia Zostericolum f. mediocris Foslie.

On Phyllospadix. Port Renfrew, B. C., *Yendo*; west coast of Whidbey Island, Wash., *N.L.G.*, No. 271!

Melobesia (Heteroderma) marginata Setchell and Foslie.

On *Laurencia pinnatifida*, *N.L.G.*, No. 270! and on *Odonthalia semicostata*, *N.L.G.*, No. 269!, both on the west coast of Whidbey Island, Wash.

Amphiroa Aspergillum f. nana Setchell and Gardner f. nov.

In loose and small tufts, among other algæ on the rocks. Fronds short, 2–3 cm. high, with branches and branchlets pinnately arranged as in the type. This form differs from the typical form only in its dwarf condition.

Upper sublitoral zone. East Sound, Orcas Island, Wash., *N.L.G.*, No. 482! The only occurrence of this species as yet in our territory is this dwarf form from Orcas Island. The typical form is found in abundance on the coast of California, and has been distributed in Collins, Holden and Setchell, P. B.-A., No. 498, under *Amphiroa nodulosa*.

Amphiroa cretacea (P. & R.) Areschoug.

Attached to rocks or even to the spines of sea urchins, in tide pools in the litoral zone and descending to a depth of 10 fathoms or more in the sublitoral zone. St. Lawrence Island

and Port Clarence, Alaska, *Kjellman* (1889, p. 21); St. Paul Island, Alaska, *Setchell* (1899, p. 595); west shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 3242!; Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 20, under *Corallina cretacea*); near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, Nos. 4093!, 4075!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5088!; Port Renfrew, B. C., *Yendo* (1902, p. 714).

This species is to be distinguished from the forms of the next by the fact that its joints are always cylindrical and never flattened in any portion of the frond. We have not attempted to distinguish between the forms, but we agree with Yendo that *Amphiroa Tasmanica* Kuetzing is probably but a form of this species and that it, or a similar form, occurs in our territory. Of the plants accessible to us and enumerated above, Nos. 3242 and 4075 are the typical form; No. 4093, which is from water of 10 fathoms in depth, agrees with the f. *Tasmanica* Yendo; while No. 5088 shows specimens of both forms growing intermixed.

Amphiroa tuberculosa (P. & R.) Endlicher (in extended sense).

After a long study of the forms of Amphiroa with flattened joints from the western coast of North America, we have come to the conclusion that they are all forms of one polymorphous species, the forms owing their very considerable differences to variations in the environmental conditions under which they may be found growing. It is our experience that all of the jointed Corallinaceæ are very susceptible to such conditions as greater or less depth of submergence, varying light, temperature, impurity or purity of water, especially the admixture, continuous or otherwise, of fresh water, exposure to air and sun when emergent, etc. The grinding of sand in the currents flowing over them or the mutilations by animals, produce variations in habit and the form of the individual joints, sufficient to disturb the typical aspect of the species. We have preferred to use the oldest specific name for the group of forms, although it is, perhaps, the least descriptive. We do not understand the reasons for referring some of the forms to the genus *Cheilosporum*, as

Yendo has done, since that genus, if separable at all from Amphiroa, applies only to a very limited number of species, none of which occur in our territory.

Amphiroa tuberculosa f. **typica** Setchell and Gardner comb. nov.

On rocks in tide pools in the litoral and upper sublitoral zones. Sitka, Alaska, *Postels and Ruprecht* (1840, p. 20), *Saunders* (1901, p. 442); Port Renfrew, B. C., *Yendo* (1902, p. 714), *Butler and Polley*, No. 11!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 83!; San Juan Island, Wash., *Tilden*, No. 301!, under *Amphiroa Californica.*

What we feel should be included under f. *typica* is well described by Yendo under *Amphiroa tuberculosa.* It is a plant which seldom, if ever, is emergent at low water and usually occurs in water of considerable depth. In plants of such habitat we usually find the joints thicker and less obcordate, though flattened, but they also frequently have branches which are cylindrical and which resemble those of *Amphiroa cretacea.* Yendo makes much of the branching of this species as being subdichotomous, but in reality the branching is pinnate, only much less so than in some of the forms of this species. The difference is not in kind, but in regularity and degree, and, consequently, not a character to separate this form and the next from the rest of the forms and give them specific rank.

Amphiroa tuberculosa f. **Californica** (Decaisne) Setchell and Gardner comb. nov.

On rocks in the upper sublitoral and in deep tide pools in the litoral zones. Puget Sound, *Bailey and Harvey* (1862, p. 162, under *Amphiroa Californica*); Strait of Juan de Fuca, *Harvey* (1862, p. 169, under *Amphiroa Californica*); Port Renfrew, B. C., *Yendo* (1902, p. 715, under *Cheilosporum Californicum*).

We have not seen the type of the species of Decaisne, but if the specimen distributed by Farlow and illustrated by Yendo, represents this species, then we feel certain that it is but a form of the polymorphous species, *A. tuberculosa.* It should be somewhat extended beyond Yendo's idea, however, and made to include all the plants which have thick, irregularly triangular joints, with

small or no projecting upper angles, yet usually more pronounced than in the preceding form. In the least development, it is the plant described and figured by Yendo, but while this may have the appearance of being di- to trichotomous, the more highly developed plant is more or less regularly pinnate and even bipinnate. It passes insensibly into the last and into the forms which are usually included under *Amphiroa Orbigniana*, which, in a less than usually slight condition of development, is represented by Harvey in the Nereis Australis (Plate 38) and commonly found on the coast of California.

Amphiroa tuberculosa f. **Orbigniana** (Decaisne) Setchell and Gardner comb. nov.

Although we have not seen a specimen of this form from our territory, it seems best to include a brief discussion of it, because of its relations, as indicated above, to the other forms. In its typical condition it is a long plant, equal in this respect to any plants we have seen of either of the two preceding forms. Its joints are thinner and more distinctly auriculate than those of the preceding form, with pinnate branching well marked. It passes into the preceding as the joints become thicker and shorter, with the auricles reduced or lacking. It also passes into a form with lax and apparently subdichotomous branching, and this is represented by the *Amphiroa Orbigniana* of No. 398 of Collins, Holden and Setchell, P. B.-A. (in our copy), which is characteristic of warmer waters. In the upper and more exposed portions of its habitat, it becomes dwarfed, the branching is more regular and pronouncedly pinnate, and it passes over into the next two forms. States of this form will probably be found at some time in the warmer waters of the Puget Sound region.

Amphiroa tuberculosa f. **frondescens** (P. & R.) Setchell and Gardner comb. nov.

On rocks in the litoral zone. West shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4004!; Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 20, under *Corallina frondescens*); Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5129a!; Port Renfrew,

B. C., *Yendo* (1902, pp. 715, 716, under *Cheilosporum frondescens* ff.); East Sound, Orcas Island, Wash., *N.L.G.*, No. 916!; west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 80!, 82!

While in some cases, the present form is fairly distinct from the next, in many cases, it is difficult to decide to which form to refer a given specimen. Yendo has recognized this when he says (1902, p. 717):—"Nevertheless, it would not be an unreasonable supposition that the hybrid between *Cheil. frondescens* and *Cheil. planiusculum* may occur in nature." He also recognizes the variability of the plants placed under each by the number of forms which he describes or refers to. The stipe, upon whose length and thickness he depends for one essential difference between the two, varies much and at times seems interchanged. We regard this as a very unreliable character. The apical joints and the thickness or thinness of their external margins do not always lead us safely, and the approximation or non-approximation of the joints seems as little satisfactory. We have retained the two forms and are able to separate them to a certain degree, but not satisfactorily.

Amphiroa tuberculosa f. **planiuscula** (Kuetzing) Setchell and Gardner comb. nov.

On rocks in the lower litoral zone, also in shallow pools in the upper litoral zone. Near Iliuliuk, Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4057!; Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5096!; Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5128!; Prince William Sound and Sitka, Alaska, *Saunders* (1901, p. 442, under *Amphiroa planiuscula*); Port Renfrew, B. C., *Yendo* (1902, p. 717, under *Cheilosporum planiusculum*), *Tilden*, No. 503!, under *Cheilosporum planiusculum;* west coast of Whidbey Island, Wash., *N.L.G.*, Nos. 81!, 918!

We have commented on the relationships of this form and on the difficulty of distinguishing it, under the preceding form. Yendo says (1902, p. 717) that it is difficult to give a sharp definition. In its most characteristic form, it is a thinner species with sharper auricles to the joints in the type of the form, slender stipe, etc., but all these vary and pass directly into the preceding

form. Such characters as these vary so much in our Amphiroas, that they are hardly good ones to establish form-characters upon, much less specific.

The *Amphiroa corymbosa* of Harvey's List (1862, p. 169), represented only by fragments in the collection he received, judging from his idea of that species as represented in the Nereis Australis (pl. 38) may also belong to this form. As to the variations of this form as represented by Kuetzing (1858, p. 31, pl. 63) they are all represented in our collections and may be classed as subforms. The subf. **laciniata** is especially well shown in specimens under our No. 4057. The subf. **antennifera** occurs more or less generally, but usually not in any considerable quantity. The subforms **normalis** and **polyphora** are not well set off from one another, but are both represented in Tilden's No. 503 in our copy of the American Algæ.

Amphiroa epiphlegnoides J. Agardh.

On rocks and other algæ. Prince William Sound and Sitka, Alaska, *Saunders* (1901, p. 442); Strait of Juan de Fuca, *Harvey* (1862, p. 169).

We do not know this species. Yendo thinks (1902, p. 715) that it is quite similar to *Amphiroa tuberculosa*, and places it provisionally under that species (our f. *typica*) as a synonym.

Corallina officinalis L.

Puget Sound, *Bailey and Harvey* (1862, p. 162); Esquimalt, B. C., *Harvey* (1862, p. 169).

After a careful and extensive consideration of the puzzling forms of Corallina of the western coast of North America, we have decided that the best arrangement, for the present, at least, is to place all the plants which have ecorniculate cystocarps under this species as forms. We have not seen the plants quoted above, and consequently place them under the species without comment.

Corallina officinalis f. **typica** Setchell and Gardner comb. nov.

The plant, seemingly to be considered as the type of the species, is to be distinguished by its more or less regularly bipin-

nate branching and the more or less slender tapering branchlets. We have not seen a specimen of this from our territory.

Corallina officinalis f. **Chilensis** (Decaisne) Kuetzing.

On rocks in the upper sublitoral and in deep pools in the litoral zone. Port Renfrew, B. C., *Yendo* (1902, p. 718).

We have seen no specimens of the type of this form, as represented by Kuetzing (1858, pl. 66 f. 1) from our territory, but it is not uncommon in various localities on the coast of California. The very simple condition represented by Kuetzing and by Yendo (1902, pl. 54, f. 1) is not so abundant as conditions with the branches and branchlets more numerous and passing into states characteristic of the second and third forms below. It seems to us that it is to be distinguished from the preceding by its less slender and less tapering branchlets.

Corallina officinalis f. **robusta** Setchell and Gardner f. nov.

The type of the present form is a plant of the Californian coast which has been distributed under 499 of Collins, Holden and Setchell's Phycotheca Boreali-Americana. It differs from the forms just mentioned in being larger and stouter, the joints being more inclined toward a triangular outline in the main axes, while the pinnules and ultimate branchlets are more or less flattened. The cystocarps and conceptacles are terminal on longer or shorter branchlets, but at times the fertile branchlet is so short that it seems sessile on the joint, or upon a projection from it.

In the upper sublitoral zone and in tide pools in the litoral zone. West coast of Whidbey Island, Wash., *N. L. G.*, No. 278!

As it occurs on the Californian coast, this form presents a series of gradations to f. *Chilensis*, but, as it becomes condensed, its aspect is sufficiently changed to give it the appearance of a very distinct plant. We suspect from the figures and descriptions of Yendo that it includes his *Cheilosporum MacMillani* (Yendo, 1902, p. 718, pl. 53, f. 4, 5, pl. 56, f. 11–14) from Port Renfrew, B. C. That agrees very well with the specimens from Whidbey Island, except that in these we have not found any cystocarps on the faces of the joints. We have seen such structures on the faces of the joints of certain Californian forms of

Corallina, but they seem to belong to a species of Choreonema. The *Cheilosporum maximum* Yendo (1902a, p. 22, pl. 2, f. 18, 19, pl. 6, f. 9) seems but a more strongly calcified state of this form, such as we have collected at Monterey, California.

Corallina officinalis f. **pilulifera** (P. & R.) Setchell and Gardner comb. nov.

On rocks in the sublitoral zone. St. Paul Island, Alaska, *Greeley and Snodgrass*, No. 5805a!; Unalaska, Alaska, *Postels and Ruprecht* (1840, p. 20, under *Corallina pilulifera*); east shore of Amaknak Island, Bay of Unalaska, Alaska, *W.A.S. and A.A.L.*, No. 4078!; Shumagin Islands, Alaska, *Saunders* (1901, p. 442, under *Corallina arbuscula*); Prince William Sound, Alaska, *Saunders* (1901, p. 442, under *Corallina pilulifera filiformis*).

A dwarf form including the *Corallina arbuscula* and *C. pilulifera* of Postels and Ruprecht. It forms a transition from f. *Chilensis* to the next, because in some cases there may be found more than two branchlets springing from one joint. The cristate joints prolonged into filiform prolongations are more or less common on the plants examined. The *Corallina pilulifera* of Kuetzing (1858, pl. 64, I) may prove to be a different species. The *Arthrocardia frondescens* of Setchell (1899, p. 595) was based on a few fragments of the *f. filiformis* of Ruprecht and was recognized later when more perfect material was discoverd among the Greeley and Snodgrass collections.

Corallina officinalis f. **multiramosa** Setchell and Gardner nom. nov.

In the lowermost portion of the litoral zone and on the edges of tide pools farther up, growing on rocks. Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5129!; Esquimalt, B. C., *N.L.G.*, No. 919!; Port Renfrew, B. C., *Yendo* (1902, p. 719, under *Corallina Vancouveriensis*); west coast of Whidbey Island, Wash., *N.L.G.*, No. 79!

This form is distinguished, as Yendo has pointed out (1902, p. 712, under *Corallina Vancouveriensis*), by having more than two branchlets springing from an articulus the rule, thus giving the plants a distinct habit. This happens to some extent in the

other forms, so that it cannot be considered to be a specific character. The form as we understand it is synonymous with the *Corallina Vancouveriensis* of Yendo, and like that, may be divided into two subforms, as follows: subf. **laxa,** equalling *C. Vancouveriensis* f. *typica* Yendo, and subf. **densa** equalling *C. Vancouveriensis* f. *densa* Yendo.

Corallina officinalis f. **aculeata** (Yendo) Setchell and Gardner comb. nov.

In tide pools, uppermost litoral zone. Port Renfrew, B. C., *Yendo* (1902, p. 720, under *Corallina aculeata*); East Sound, Orcas Island, Wash., *N.L.G.*, No. 917!

Corallina aculeata Yendo is simply the distorted state of the preceding form and the prickly, confusedly ramulose, and flattened or angled branchlets, imperfectly, or in some cases, unusually much calcified, are all due to unfavorable conditions of environment.

Corallina gracilis Lamouroux.

Mr. F. S. Collins has determined with some doubt, a specimen collected by Misses Butler and Polley at Port Renfrew, B. C., as belonging to this species.

Hildenbrandtia prototypus Nardo.

On rocks in the middle litoral zone. Harvester Island, Uyak Bay, Kadiak Island, Alaska, *W.A.S. and A.A.L.*, No. 5109!; west coast of Whidbey Island, Wash., *N.L.G.*, No. 406!; Tracyton, Kitsap County, Wash., *Tilden*, No. 201!, under *Peysonnellia Dubyi*.

The plants placed under this species are dark blood red and represent what has been called *H. sanguinea*. They are darker and thicker than the next.

Hildenbrandtia prototypus f. **rosea** Hauck.

On stones in the lower litoral and upper sublitoral zones. Port Clarence, Alaska, *Kjellman* (1889, p. 26, under *Hildenbrandtia rosea*); Shumagin Islands to Puget Sound, *Saunders* (1901, p. 441, under *Hildenbrandtia rosea*); west coast of Whidbey Island, Wash., *N.L.G.*, No. 128!

A much thinner species than the last, of a rose red color, and may represent a distinct species.

LIST OF GEOGRAPHICAL NAMES.

We have given the localities for the different species with as much fulness as possible, in order that the distribution may be made as plain as may be done at present. Since there are many names more or less unusual and some which may not readily be found upon the ordinary maps and charts, we have prepared a list of all the names used, with the geographical positions definitely stated. These notes, and the determinations of the latitudes and longitudes, have been generously provided by Professor George Davidson of the University of California.

ALASKA.

Agattu Island. The southernmost of the two most western islands of the Aleutian chain. The west point is in Lat. 52°55′ N. and Long. 173°10′ E.

Amaknak Island. This is the long, high island, lying broad in the middle of the Bay of Unalaska, and giving the protection to Captains Harbor (Captains Bay), to Dutch Harbor, and to Iliuliuk. The northernmost part is named Cape Ulakhta, whose position is Lat. 53°56′ N. and Long. 166°28½′ W.

Annette Island. This large island lies in the southern part of the Archipelago Alexander, between the channel Revilla Gigedo on the east and Clarence Strait on the west. The position of the village of Metlakatla is Lat. 55°07′ N. and Long. 131°35′ W.

Bay of Morozof. A large bay on the SE. shore of the Peninsula of Alaska. Position of the western point of entrance, Lat. 54°54′ N. and Long. 162°54′ W. The spelling of the latest charts of the U. S. C. and G. Survey reads Morzhovoi Bay. Other spellings are Marshovo Bay, Morzovia Bay, Bay Morozova, and Morsheovi Bay. Another name is Walrus Bay.

Bay of Unalaska. A very extensive bay on the NE. part of Unalaska Island, broad open to the Bering Sea. The two outer heads are Cape Kalekhta (on the east) and Cape Cheerful (on the west), eight miles apart. It stretches into the mountainous part of the island, 12 n. miles in a general SSW. direction. Inside are several minor bays or anchorages, viz.: Captains Harbor or Bay in the extreme SW., Iliuliuk Harbor, Dutch Harbor, Summer Harbor or Bay, and Constantine Anchorage. The position of Cape Kalekhta is Lat. 53°59½′ N. and Long. 166°20′ W.

Berg Bay. A small fiord on the west shore of Glacier Bay of Icy Strait, 12 n. miles inside Points Carolus and Gustavus. The position of a small islet in the entrance is Lat. 58°28′ N. and Long. 136°07′ W.

Alaska—(*continued.*)

Besboro Island. A small islet, about 4 miles N.& S., in the easternmost part of Norton Sound and within 12 miles of the eastern shore. It is 45 n.miles NE. from St. Michael and 15 n. miles nearly directly south from Cape Denbigh. Its position is Lat. 64°08′ N. and Long. 161°20′ W.

Cape Denbigh. This is the SE. point of entrance to Norton Bay which, in turn, is the extreme NE. part of Norton Sound. Its position is Lat. 64°16′ N. and Long. 161°43′ W.

Cape Dyer. There are five capes at the northwestern part of the great delta of the Yukon River, the northern most of which is Cape Dyer. Its position is Lat. 61°51′ N. and Long. 166°06′ W.

Cape Nome. This is the long, low, rounding cape, between Cape Rodney (on the west) and Cape Darby (on the east), called the Middle Cape by the Russians. Its position is Lat. 64°25′ N. and Long. 165°05′ W.

Cormorant Rocks. A small cluster of rocks, exposed at low tide in Uyak Bay, one-half mile SSE. from the Uyak Anchorage under Harvester Island. Their position is Lat. 57°37′ N. and Long. 153°58½′ W.

Captains Bay. This is more properly Captains Harbor, the head of the broad and extensive Bay of Unalaska. The NW. point of entrance lies in Lat. 53°53′ N. and Long. 166°32′ W.

Cook Inlet. This is that great arm of the Pacific waters reaching a higher latitude than any other east of the Peninsula of Alaska. It lies between the mainland volcanic range of Redoubt and Iliamna on the west and the Kenai Peninsula on the east. Its entrance is between Cape Elizabeth on the east and Cape Douglas on the west, where it is 46 n. miles wide. Its general direction is NE., and in approaching the head it swings to the east with a mouth 15 miles wide. The position of Cape Elizabeth is Lat. 59°06′ N. and Long. 151°48′ W.

Delarof Harbor. A moderately deep harbor on the SE. arm of Unga Island. The position of the entrance is Lat. 55°10′ N. and Long. 160°25′ W.

Douglas. A small village on Douglas Island, on the south side of Gastineau Channel, opposite Juneau.

Dutch Harbor. In the deep Bay of Unalaska, there is on the NW. side of the Bay or Harbor of Iliuliuk, a long gravel and boulder ridge that forms a good Harbor. It has been called also Lincoln Harbor, from the U.S. Revenue Cutter Lincoln (in 1867), later Ulakhta Harbor (U.S.C. & G. Survey, 1869), and finally Dutch Harbor. The position of the end of the gravel spit is Lat. 53°53′57″ N. and Long. 166°-28′35″ W.

Glacier Bay. An extensive fiord, stretching from the north shore of Icy Strait of the Russians and Cross Sound of the English, for 40 n. miles to the NW. and receiving the waters from the Muir and 6 other glaciers. The entrance is 3½ miles wide, between Point Gustavus on

ALASKA—(*continued.*)

fathoms, and it is frozen over and full of ice from October to May or June. The middle point of the western boundary (Long. 166° W.) is Lat. 63°25′ N.

Ocean Cape. The low SE. entrance to Yakutat Bay. Its position is Lat. 59°33′ N. and Long. 139°48′ W.

Orca. A salmon cannery in the easternmost portion of Prince William Sound, with shoal water communication with the Pacific Ocean. Its waters are cold from glacial ice in the Sound and streams from the Snow Mountains to the east. Its position is Lat. 60°36′ N. and Long. 145°40′ W.

Pinnacles or Pinnacle Rocks. There are several Pinnacle or Priest Rocks in the neighborhood of Unalaska Bay. Those referred to in the text are on the SW. point of Summer Bay. Their position is Lat. 53°54′ N. and Long. 166°27′ W.

Point Barrow. On the Arctic Coast of Alaska, 210 geographical miles from Bering Strait, following the coast line from point to point. Its position is Lat. 71°22′ N. and Long. 156°12′ W.

Popof Island. The high and rocky island lying east of the NE. point of Unga Island, one of the Shumagin group, the strait between them being not quite a mile wide. Sand Point is the westernmost point. Its position is Lat. 55°20′ N. and Long. 160°33′ W.

Port Clarence. A well protected bay of nearly circular form, 10–12 n. miles in diameter, ESE. 35 n. miles from Cape Prince of Wales. A long, low, narrow spit encircles the bay from S. to W., and then N., nearly to the north shore, under which the entrance lies. The position of Cape Spencer, the end of the spit, is Lat. 65°15′ N. and Long. 166°52′ W.

Prince William Sound. A large area of water and islands in the NW. part of the Gulf of Alaska and 160 n. miles west of Mt. St. Elias. Several large islands protect the seaward part of the sound, but there are three good channels leading into it. From the eastern to the western parts, it is 80 n.miles in breadth, and from the SW. entrance to the mainland west of Port Valdés, it is 70 n.miles. It is notable for many deep fiords, penetrating the mountainous surroundings, and at the heads of most of the fiords, are glaciers, some coming down to the waters edge. Just east of the eastern entrance, the cold waters of the Copper River come down with much detritus in suspension. The waters of this sound are probably much colder than the adjacent waters of the Gulf of Alaska. The towns on the shores of Prince William Sound, at present, are Orca, a canning station in the eastern part (cf. above), Valdés, a mining camp, and Nutchek or Constantin, the old Russian trading establishment, near the eastern entrance. The position of the last is Lat. 60°20′ N. and Long. 146°53′ W.

ALASKA—(*continued.*)

Safety Harbor. Just east of Cape Nome, on the north shore of Cape Nome, is a small and shoal bay or lagoon, lying between the beach and the foot of the gravel diggings behind it. It is connected directly with the ocean. It is frozen all winter. The entrance is less than 10 miles east of Cape Nome and its position is Lat. 64°27′ N. and Long. 164°45′ W.

Saldovia. A small settlement on the small Bay of Cheslokuu, which is 8 n. miles to the northeast of Port Graham at the SW. point of the entrance to Kochemak Bay, which, in turn, opens broadly upon Cook Inlet. Its position is Lat. 59°27′ N. and Long. 151°39′ W. Saunders collected at this locality and has recorded it (1901) as "Seldovia," which we have followed. The correct spelling, according to Professor Davidson, is "Saldovia," as above.

Sand Point. Sand Point stretches out from the NW. part of Popof Island, one of the Shumagin Group, towards the NE. part of Unga Island, and narrows the strait. Its position is Lat. 55°20′ N. and Long. 160°33′ W.

Sannak Island. This is the southwesternmost of the many islands lying off the southeast coast of the Peninsula of Alaska and the outermost one off the Strait of Isanof. It is surrounded by dangerous reefs. The position of Unimak Cove, on the north side, is Lat. 54°27′ N. and Long. 162°40′ W.

Seldovia. See Saldovia.

Shumagin Islands. This group of twelve large, high islands was first visited by Bering in the first week of September, 1741. They are embraced between Latitudes 54°43′ N. and 55°34′ N. and Longitudes 159°12′ W. and 160°50′ W., the general direction of the group being NW. and SE., but of the individual islands NE. and SW. The collections have been made chiefly, if not entirely, on the islands of Unga and Popof.

Sitka. The capital of Alaska, on the Island of Baranof, at the easternmost part of Sitka or Norfolk Sound. Its position is Lat. 57°03′ N. and Long. 135°18′ W.

Skaguay. A town near the head of Taiya Inlet, which is a prolongation of Lynn Canal. Its position is Lat. 59°27′ N. and Long. 135°19′ W.

St. Lawrence Island. A large island in the Bering Sea, 150 miles south of Bering Strait. It is 100 statute miles long ESE. to WNW. The position of the NW. cape is Lat. 63°53′ N. and Long. 171°30′ W.

St. Michael. An old trading post of the Russian Fur Company, on an island of the same name, close under the mainland, 60 miles north of the Aproon Branch of the Yukon river. Its position is Lat. 63°32′ N. and Long. 161°45′ W.

ALASKA—(*continued.*)

St. Paul. The town of St. Paul and the anchorage are at the NW. part of Kadiak Island and are protected by the outlying islands, Near, Crooked, Holiday, Wooded, and Long or Bare Island, the last two being large ones. The town is often spoken of and written of, as Kadiak or Kodiak. Its position is Lat. 57°48′ N. and Long. 152°21′ W.

St. Paul Island. One of the Pribilof Islands in the southern part of Bering Sea and near the SW. edge of the 100-fathom plateau and in the cold water Yukon region. It is the breeding place of the Alaskan Fur Seal. Its position is Lat. 57°08′ N. and Long. 170°20′ W.

Summer Bay. This is a slight indentation in the eastern shore of the Bay of Unalaska, 2 miles ENE. from the extremity of the spit of Dutch Harbor (Lincoln Harbor or Ulakhta Harbor) and 3 miles NE. by E. from the village of Iliuliuk. Its position is Lat. 53°54′ N. and Long. 166°27′ W.

Unalaska. One of the largest of the Aleutian Islands, extending E. and W. through 80 miles, with the shore broken on all sides by deep fiords, and containing several native villages and good harbors. The principal harbors are in the vicinity of the Bay of Unalaska, especially Dutch Harbor, Captains Bay, and Iliuliuk. The position of Cape Kalekhta, the NE. point of approach to the bay, is Lat. 53°59′ N. and Long. 166°18′ W.

Unga Island. One of the Shumagin Islands off the SE. coast of the Peninsula of Alaska, about 20 miles in length. There is a moderately deep harbor at the SE. arm, the Bay or Harbor of Delarof, about 2 miles in depth and ⅔ of a mile in breadth. The position of the entrance is Lat. 55°10′ N. and Long. 160°25′ W.

Uyak Bay. On the northwestern shore of Kadiak Island, with the entrance 9 miles open to the north. It is 30 geographical miles deep. Inside the SE. point of entrance are two islands with an anchorage under the inner one, 7 miles from Cape Uyak. The larger one is known as Harvester Island. Its position is Lat. 57°39′ N. and Long. 153°56′ W.

Valdés. A mining town on a glacial delta at the head of Port Valdés, an inlet at the extreme northeastern part of Prince William Sound. Its position is Lat. 61°06′ N. and Long. 146°26′ W. The postoffice at the town is known as Valdez.

Virgin Bay. At the SE. side of the entrance to Port Valdés, lies Bligh Island (of Vancouver), which is really three islands lying close together, and on the mainland, protected by this group, are three small bays. The middle one has copper works on the south side, and this is the Virgin Bay of the Harriman Expedition of the summer of 1899. At the northwestern point of this small bay is the native village of Tatitlack, whose position is Lat. 60°50½′ N. and Long. 146°48′ W.

Wrangell. On the north point of Wrangell or Etolin Island and 8 miles south from the southern mouth of the Stakheen River. Its position is Lat. 56°28′ N. and Long. 132°22′ W.

Alaska—(*continued.*)

Yakutat. A town and postoffice, inside of Ocean Cape, on the shores of Yakutat Bay, 4 miles east of the Cape. Its position is Lat. 59°33′ N. and Long. 139°40′ W.

Yakutat Bay. A broad, open bay about 60 miles ESE. from Mt. St. Elias. The low gravel shores on the west side drain part of the Malaspina Glacier. The southeast point of entrance is Ocean Cape, whose position is Lat. 59°33′ N. and Long. 139°48′ W.

British Columbia.

Banks Island. The westernmost of the islands lying off the mainland in the latitude of 52°–54° N., and forming in part the eastern shore of Hecate Strait, Queen Charlotte Archipelago forming the western. The island is 41 miles long and 5-10 miles wide, with the shores broken into bays and creeks. Calamity Harbor at the southern end is in Lat. 53°10′ N.

Burrards Inlet. Opening into the Gulf of Georgia at the northeastern part and just inside is the town of Vancouver, the terminus of the Canadian Pacific railroad. The position of the light-house is Lat. 49°17′14″ N. and Long. 123°15′08″ W.

Departure Bay. This is a coal harbor, on the eastern shore of Vancouver Island, and the northern part of Nanaimo Harbor. Its position is Lat. 49°12′ N. and Long. 123°58′ W.

Esquimalt. A small harbor just west of Victoria, on the southeastern coast of Vancouver Island. Its position is Lat. 48°25′50″ N. and Long. 123°26′45″ W.

Fort Vancouver. This is a locality given by Harvey (1852, p. 210). We supposed it to refer to Vancouver, B. C., but it probably refers to the Fort Vancouver on the Columbia River in Oregon.

Gonzales Point. Three miles east of Victoria. Position Lat. 48°24′ N. and Long. 123°18′ W.

Lowe Inlet. This small inlet opens on the Grenville Channel about 14 n. miles northwestward from the south entrance to the channel. Its position is Lat. 53°31′ N. and Long. 129°33½′ W.

Nanaimo. A small town on a small bay opening upon the Gulf of Georgia. Its position is Lat. 49°10′ N. and Long. 123°57′ W.

Nootka Sound. One of the deep bays or fiords on the western coast of Vancouver Island. The position of Friendly Cove, the old landing place within the Sound, is Lat. 49°36′ N. and Long. 126°37½′ W.

Oak Bay. A small shoal bay two miles north of Gonzales Point.

Pedder Inlet. A small bay near Cape Church, the southernmost point of Vancouver Island. It is nearly 10 miles SW. of Victoria.

Peddler Inlet. A misprint in the text for Pedder Inlet.

BRITISH COLUMBIA—(*continued.*)

Point Roberts. Extends from the mainland westward into the Gulf of Georgia. The extremity of the point is in the State of Washington. Its position is Lat. 48°58′15″ N. and Long. 123°04′16″ W.

Port Renfrew. A new name given to the location on San Juan Harbor or Port San Juan, where the University of Minnesota has established a marine laboratory. It is variously mentioned under the names Minnesota Seaside Station, Baird Creek, Baird Cove, Baird Point, etc., as far as we understand the situation. It is about 60 or 70 miles to the west of Victoria.

San Juan Harbor. This is the first bay or harbor on the Vancouver Island side of the Strait of Juan de Fuca in approaching from the sea. Observatory Rocks, at the eastern head, are in Lat. 48°31′30″ N. and Long. 124°28′15″ W.

Straits of Georgia. The straits or more properly, the Gulf of Georgia, are between the mainland of Washington and British Columbia on the east and Vancouver Island on the west. The position of Point Roberts on the eastern side has already been given.

Strait of Juan de Fuca. This is the first large strait on the NW. coast of North America as one comes from the southward. Its western entrance lies between Cape Flattery in Washington and Cape Bonilla on Vancouver Island. The position of Cape Flattery, as determined at the light-house on Tatoosh Island, off the cape, is Lat. 48°23′15″ N. and Long. 123°43′51″ W.

Sumas Prairie. This locality is unknown to us.

Vancouver Island. A large island on the western coast of British Columbia, extending from Lat. 48°18½′ N. at the Strait of Juan de Fuca to Cape Scott in Lat. 50°47′ N.

Victoria. The capital of the province of British Columbia, situated in the southeastern part of Vancouver Island. Its position is Lat. 48°25′31″ N. and Long. 123°23′39″ W.

Una Nootka. Probably in the neighborhood of Nootka Sound, but not known definitely.

WASHINGTON.

Bog Lake. A small lake on Whidbey Island.

British Camp. The site of the British Camp is in the NW. part of San Juan Island. Its position is Lat. 48°35′ N. and Long. 123°10′ W.

Brown Island. This is a small island in Friday Harbor on the eastern shore of San Juan Island. Its position is Lat. 48°32′ N. and Long. 123°00′ W.

Camano Island. A long narrow island, lying off the eastern and southern part of Whidbey Island and the NW. point or shoulder is just east of

WASHINGTON—(*continued.*)

Penns Cove. This point, Point Demock, is in Lat. 48°15′ N. and Long. 122°32′ W.

Chambers Creek. Near the city of Tacoma, apparently not charted.

Channel Rocks. This name is used by Gardner in his collections, with the statement that the rocks are near Seattle, and it is also used by Miss Tilden, with the qualifying phrase, near Port Orchard. They are probably the same and lie in the narrow crooked channel leading from Admiralty Inlet to the southern part of Port Orchard. The position of the entrance of the south channel is Lat. 47°34½′ N. and Long. 122°32′ W.

Coupeville. A town, situated on the southern shore of Penns Cove, which is on the inside of Whidbey Island. Its position is Lat. 48°13′ N. and Long. 122°41½′ W.

Crocket's Lake. This is the marshy lagoon just east of Admiralty Head. A low gravelly beach separates it from Admiralty Bay. The position of the light-house on Admiralty Head is Lat. 48°09¼′ N. and Long. 122°41′ W.

Deer Harbor. A small town and bay, not charted, on the SW. side of San Juan Island.

East Sound. This is a fine sound nearly cutting Orcas Island in two. At the head of the sound is the village of East Sound. The position of the SE. point is Lat. 48°36′ N. and Long. 122°50′ W.

Fairhaven. This is a cannery and mill town in the northeastern part of Bellingham Bay, which, in turn, is the northeastern part of Washington Sound. Its position is Lat. 48°43′ N. and Long. 122°31′ W.

Fidalgo Island. This is a large high island at the northeasternmost part of the Strait of Juan de Fuca and forms the SE. side of Rosario Strait. It is separated from Whidbey Island by a narrow crooked strait called Deception Pass. The position of the SW. point, at Deception Pass, is Lat. 48°25′ N. and Long. 122°40′ W.

Fort Nisqually. This is an old post of the Hudson Bay Company at the mouth of the Nisqually River which empties into Puget Sound at its Great Southern Bend. Its position is Lat. 47°03′ N. and Long. 122°39′ W.

Friday Harbor. On the eastern shore of San Juan Island, about midway from the SE. and NW. points. The position of Friday Harbor Village is Lat. 48°32′ N. and Long. 123°01′ W.

Griffin Bay. The SE. extremity of San Juan Island swings well into the east and on the eastern side, just north of the entrance of San Juan Channel, there is a curve of the shore, 4-5 miles in length called Griffin Bay. The position of the village of San Juan on this shore is Lat. 48°28′ N. and Long. 123°00′ W.

Hog Island. A small island, not named on the charts, near LaConner.

Idlewild. Not known to us, but probably a summer resort. It is said to be on San Juan Island.

WASHINGTON—(*continued.*)

Keyport. A station where experimentation with oysters is being carried on, on the west side of Port Orchard, between the north and south entrances.

LaConner. This town is on the east side of the southern extremity of Swinomish Slough which forms the eastern boundary of Fidalgo Island. The position of the light-house at LaConner is Lat. 48°23′ N. and Long. 122°30½′ W.

Lake Washington. This lake lies parallel to the Admiralty Inlet and 4-6 miles to the eastward. The position of the southern extremity of the lake, where the Black River leaves it, is Lat. 47°29′ N. and Long. 122°14′ W. Seattle lies on the middle part of the western shore.

Ludlow Bay. The more proper designation, geographically, is Port Ludlow. It is on the west side of Admiralty Inlet, just at the broad entrance to Hoods Canal. The position is Lat. 47°55½′ N. and Long. 122°41′ W.

Mats-Mats Bay. This is a very small bay at the northwest entrance to Port Ludlow (Ludlow Bay) and 2 miles north of the town of Port Ludlow. The position of Basalt Point, at the south side of the entrance, is Lat. 47°57½′ N. and Long. 122°40½′ W.

Minnesota Reef. As far as we can determine, this is a name applied by collectors from Minnesota University, to a small ledge more or less uncovered at low water, in Friday Harbor, San Juan Island.

Monroe's Landing. A local name for a locality very near Coupeville on Whidbey Island.

Mt. Vernon. A RR. town on the Skagit River. Its position is Lat. 48°25′ N. and Long. 122°20′ W.

Newhall. This village is on the eastern shore of East Sound of Orcas Island, 3½ miles north of the SE. point of entrance. Its position is Lat. 48°38½′ N. and Long. 122°52′ W.

New Whatcom. This is the coal city of Bellingham Bay at the northeastern part of Washington Sound. Its position is Lat. 48°45′ N. and Long. 122°49½′ W.

Nooksack River. A moderately large stream, one of whose mouths empties into Bellingham Bay, about 6 miles NW. from the city of New Whatcom.

North Bay. A small bay on the eastern shore of San Juan Island about 4½ n.miles from the southern entrance to San Juan Channel. The position of the south side of the head forming the north shore of the bay is Lat. 48°31′ N. and Long. 128°58½′ W.

Oak Harbor. A small bay and village on the eastern shore of Whidbey Island, at the head of Saratoga Passage, about 6 miles NE. from Coupeville. Its position is Lat. 43°16′ N. and Long. 122°42′ W.

WASHINGTON—(*continued.*)

Orcas Island. This is the largest of the islands lying between Vancouver Island and the mainland. It forms the northwestern shore of the Strait of Rosario. From N. to S., it is about 9 miles wide, and from E. to W., it is about 13 miles long. The position of Point Lawrence, on the eastern side, is Lat. 84°39½′ N. and Long. 122°44½′ W.

Penns Cove. This is small bay on the eastern side of Whidbey Island. The town of Coupeville is on the south side of the bay.

Pleasant Beach. A summer resort on the north side of Richards Passage, on Bainbridge Island, at the southern entrance to Port Orchard.

Port Angeles. This is also sometimes called False Dungeness and is on the southern shore of the Strait of Juan de Fuca, 55 n. miles inside Tatoosh Island. All the coast is either wooded high bluffs or rocky, but the sand spit, which forms this port is long and narrow, stretching out from the bluff in an ENE. direction. The position of the light-house at the eastern end of the spit is Lat. 48°08′21″ N. and Long. 123°23′42″ W.

Port Orchard. Port Orchard is on the "Great Peninsula" between Admiralty Inlet on the east and Hoods Canal on the west. It is a long narrow arm of these interior waters 14 n.miles long NNE. and SSW., with two entrances. The southern entrance is by a crooked channel, named Richards Passage, opening upon a western recess of the western shore of Admiralty Inlet, and the SW. tail is the U. S. Navy Yard, called the Puget Sound Naval Station whose position is Lat. 47°33½′ N. and Long. 122°39′ W.

Port Townsend. At the southeastern extremity of the Strait of Juan de Fuca and at the north entrance to Admiralty Inlet. The position of the light-house is Lat. 48°08′39″ N. and Long. 122°45′14″ W.

Puget Sound. Legally, all the waters inside the Strait of Juan de Fuca, Washington Sound, Admiralty Inlet, Hoods Canal, etc., are known as Puget Sound. Vancouver, however, gave the name to the waters at the southern part of all these channels from Port Defiance in Lat. 47°19′ N. to the head of all at Olympia, in Lat. 47°02′ N. As a general designation in popular usage, the term is coincident with, or even somewhat more extensive than the legal application.

Renton. This is a town at the southern end of Lake Washington, where the waters drain off into the Black River. Its position is Lat. 47°29′ N. and Long. 122°14′ W.

Roach Harbor. An incorrect spelling in the text for Roche Harbor, which is a small village and harbor on the northwestern shore of San Juan Island. The position of the village is Lat. 48°36½′ N. and Long. 123°09′ W. The entrance to the harbor is protected by Henry Island.

Sackmans Point. Not named on the charts, but near Tracyton.

WASHINGTON—(*continued.*)

San Juan Island. A large, high island, 15 miles NW. and SE., which forms the SW. side of the S. entrance of the Canal de Haro and extends to a point near Victoria, B. C. The position of the SE. point is Lat. 48°27′ N. and Long. 122°58½′ W.

Seattle. A large city, situated on Elliots Bay, which opens on Admiralty Inlet, 45 miles from the Strait of Juan de Fuca. The position of the light-house is Lat. 47°39′43″ N. and Long. 122°26′03″ W.

Snakalum Point. On the east coast of Whidbey Island, about 3 miles east from Coupeville.

Swantown. A local name for a place on the west coast of Whidbey Island, about 10 miles north of Coupeville.

Tacoma. This is a city at the SW. angle of Elliot Bay, which opens to the NW. upon Admiralty Inlet. The position of the front of the city is Lat. 47°16′ N. and Long. 122°27′ W.

Tracyton. This is a village on the western side of the Port Washington Narrows which connect Dyer Inlet on the NW. with Port Orchard. The position is Lat. 47°36′ N. and Long. 122°39′ W.

Whidbey Island. A long island forming the eastern extremity of the Strait of Juan de Fuca. The position of the extreme western point is Lat. 48°12′55″ N. and Long. 122°45′31″ W.

SIBERIA.

Bering Island. A large island, the westernmost of the Aleutian Islands, 95 miles from the nearest cape of Kamtschatka. The position of the NW. point is Lat. 55°18′ N. and Long. 165°42′ E.

Konyam Bay. This bay is the northwesternmost of the bays which open on the Strait of Seniavin. It opens to the SE. upon that strait, but 6 miles in front of it is the island of Ka-y-ne or Arakamtchetchene. Lütke calls the bay Penkegnei and this name is found on the charts. The position of Cape Netchkonome, the N. point of entrance, is Lat. 64°49½′ N. and Long. 172°44½′ W.

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PLATE 17.

Collinsiella tuberculata Setchell and Gardner gen. et sp. nov.

1. Habit of No. 403, N.L.G., from Whidbey Island. (× 40)
2. Vertical section through one of the fronds. (Zeiss 2 × A)
3. Dissection of a portion of the vertical section which has been treated with Chloriodide of Zinc, to show the branching. The cell contents are much shrunken. (Zeiss 2 × D)
4. Tangential section at the surface to show the division planes. (Zeiss 2 × D)
5. Young terminal cell, untreated, showing the chromatophore lining the wall and the solitary pyrenoid. (Zeiss 2 × D)
6. Similar view of an older cell, showing the vacuolate appearance of the chromatophore. (Zeiss 2 × D)
7. Similar view of still older cell, showing the decrease in size of the chromatophore and a double pyrenoid. (Zeiss 2 × D)

Codium Ritteri Setchell and Gardner sp. nov.

8. Habit of the type specimen. (nat. size)
9. A common shape of the adult utricle. (Zeiss 2 × A)
10. A common shape of the adult utricle. (Zeiss 2 × A)
11. An uncommon, yet not rare, shape of the adult utricle. (Zeiss 2 × A)

Rhodochorton subimmersum Setchell and Gardner sp. nov.

12. A section through the host plant, showing the horizontal immersed filament of the Rhodochorton and the vertical emergent filaments, as well as the terminal tetrasporangia. Specimen No. 289, N.L.G., from Whidbey Island. (Zeiss 2 × D)

All the figures of this plate were drawn under the direction of W. A. Setchell by H. N. Bagley. The size varies proportionally to the original, and in the case of microscopic details we shall mention here, as well as under the remaining figures, only the combination of the lenses used. The drawings have all been reduced to one-half the original diameter, but the magnifications, where given, refer to the figures as reduced.

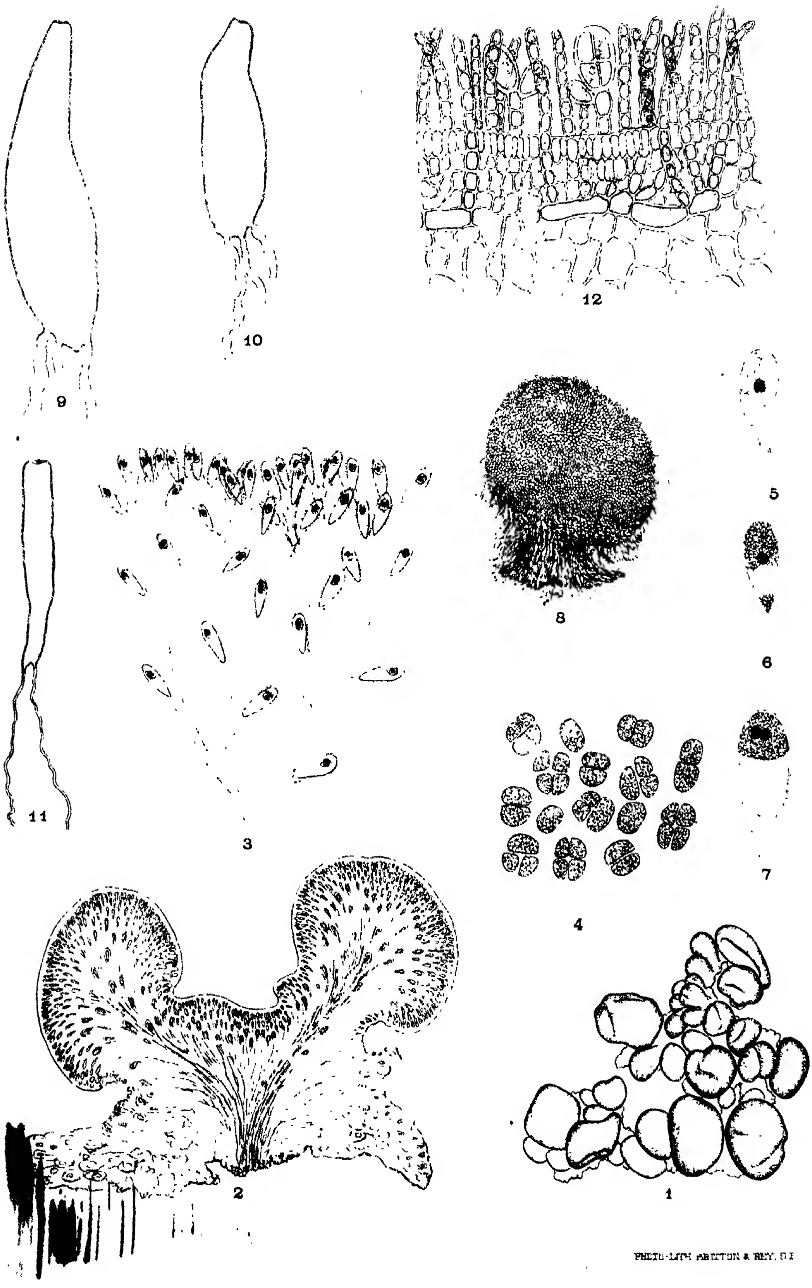

PHOTO-LITH BRITTON & REY, S.F.

PLATE 18.

Colpomenia sinuosa f. deformans Setchell and Gardner f. nov.

13. Habit of a plant showing only a comparatively slight and uniform lobing. Original from Pt. Carmel, Monterey County, California. (nat. size)
14. Habit of a plant from the same spot as the preceding, showing the tendency towards unequal lobing. (nat. size)
15. Habit of a group of plants of the type of the form. Any one of these plants may be separated and become the *Scytosiphon bullosus* Saunders. (nat. size)

Chordaria abietina Ruprecht.

16. Habit of a group of very young plants, showing the horizontal lobed thallus, whence the young vertical thalli are arising. Original material from Point Carmel, Monterey County, California. (a little more than natural size)
17. Habit of a plant just reaching the adult condition, showing the relation between the horizontal and vertical thalli. From the same place. (nat. size)

Constantinea Sitchensis P. & R.

18. Habit of a young plant, showing the method of producing the new blade by the appearance, at first, of a subulate projection in the center of the old blade. Original material from Whidbey Island. (about one-half nat. size)

Constantinea simplex Setchell.

19. Habit of a plant from Fort Ross, Caiifornia, showing the first stages of the production of the new blade by the rosulate process. (about one-half nat. size)
20. Habit of a plant in which the process of producing the new blade is farther advanced. (about one-half nat. size)
21. Habit of plant still farther advanced. (about one-half nat. size)

All the figures were drawn under the direction of W. A. Setchell. Figures 13–17 were drawn by H. N. Bagley, and the rest by A. A. Lawson.

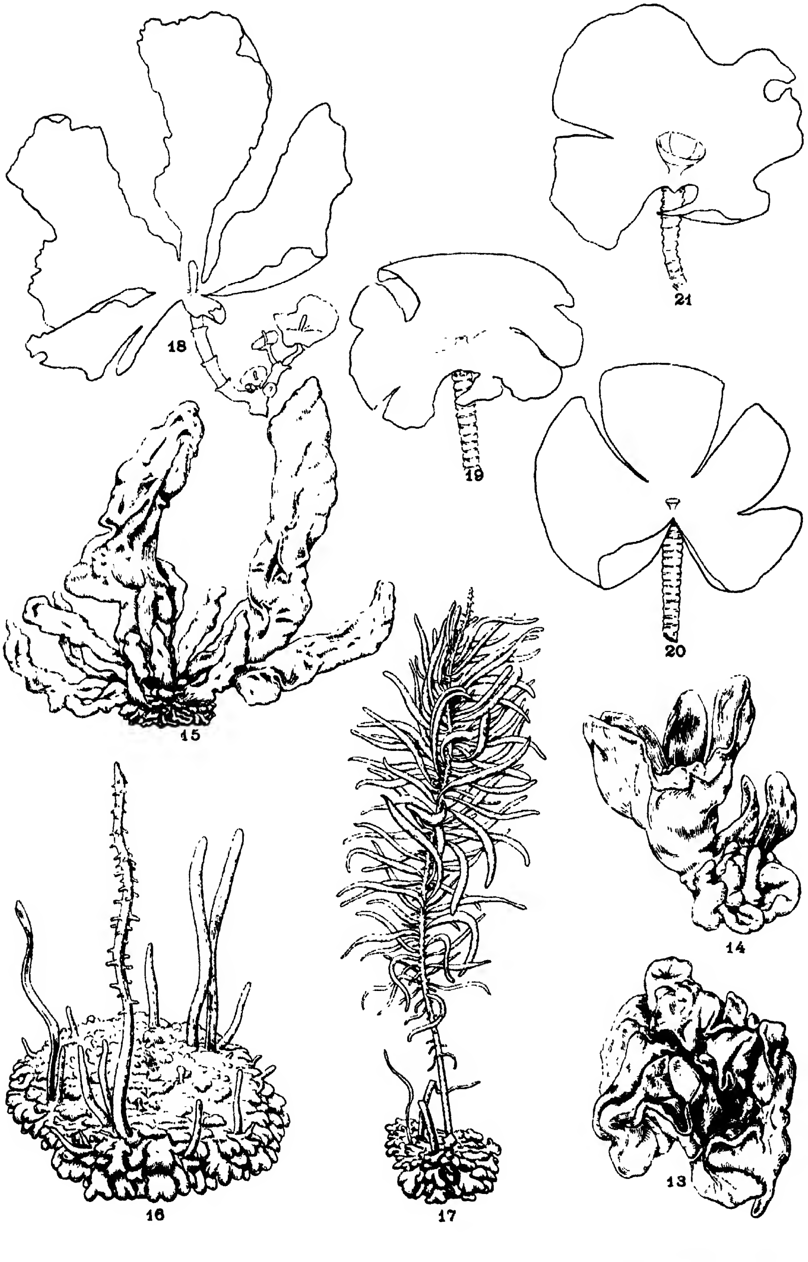

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PLATE 19.

Oscillatoria splendida f. uncinata Setchell and Gardner f. nov.

22. Tip of specimen from Oak Harbor, showing a slight tendency toward uncinate form. (× 1000-1500)
23. Tip of another specimen from the same locality and of the same magnification, showing a spiral twist.
24. Tip of another specimen from the same locality and of the same magnification, showing the extreme bending.

Pterosiphonia arctica (J. Agardh) Setchell and Gardner comb. nov.

25. Habit of portion of robust specimen from Unalaska. (nat. size)
26. Tetrasporic branchlet. (Zeiss 2 × D)
27. Cross section through the base of a branchlet. (Zeiss 2 × D)

Sarcophyllis pygmæa Setchell comb. nov.

28. Habit of a group of very young plants, showing the horizontal thallus with the young vertical fronds arising just within the margins. (nat. size)
29. Habit of young plant, showing the symmetrical horizontal thallus with two erect fronds about half grown. (nat. size)

Fauchea Gardneri Setchell.

30. Habit of a portion of the frond of a tetrasporic plant, showing the size, shape, and relative arrangement of the sori. (nat. size)

All the figures were drawn under the direction of W. A. Setchell and N. L. Gardner. Figures 28 and 29 were drawn by A. A. Lawson, the rest by H. N. Bagley.

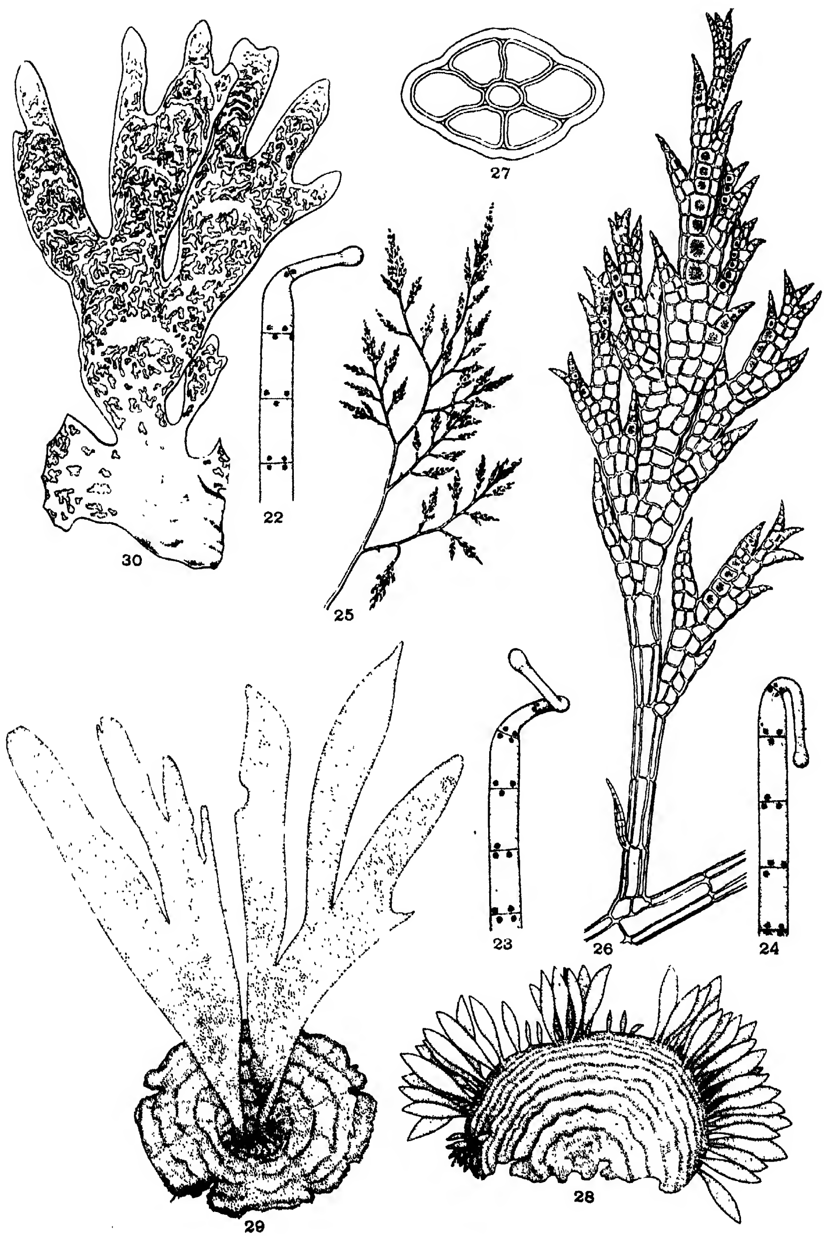

PHOTO. LITH BRITTON & REY

PLATE 20.

Hedophyllum subsessile (Areschoug) Setchell.

31. Habit of a half grown plant, showing the very short and stout stipe with its holdfast, the thickened base of the original blade from which the central portion has worn away, and the two blades borne on either side. The thickened base of the old blade gives off hapteres, some of which are shown in the figure. (about one-half nat. size)

Drawn by A. A. Lawson, under the direction of W. A. Setchell.

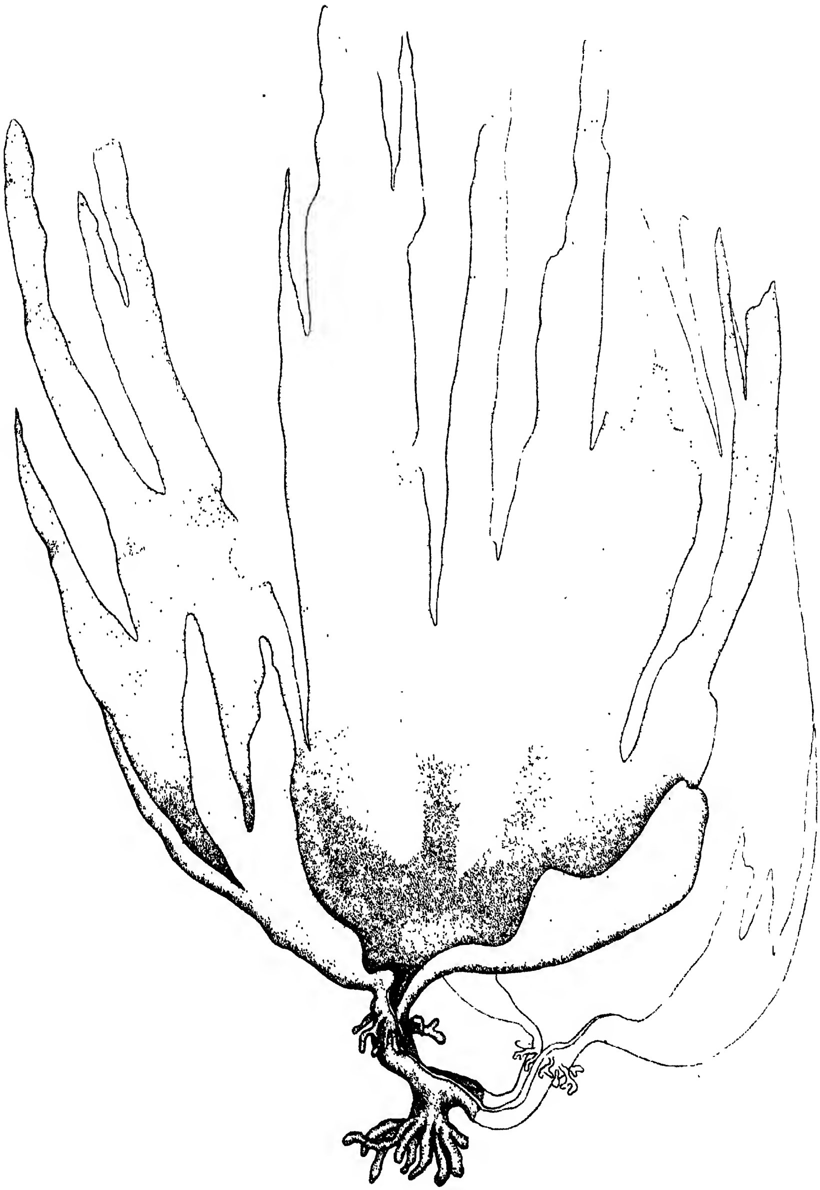

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PLATE 21.

Alaria valida Kjellman and Setchell sp. nov.

32. Habit of No. 111, N.L.G., from Whidbey Island. ($\times \frac{1}{6}$)
33. Cross section of the midrib of the same plant. ($\times 2\frac{1}{2}$)

Drawn by H. N. Bagley, under the direction of W. A. Setchell.

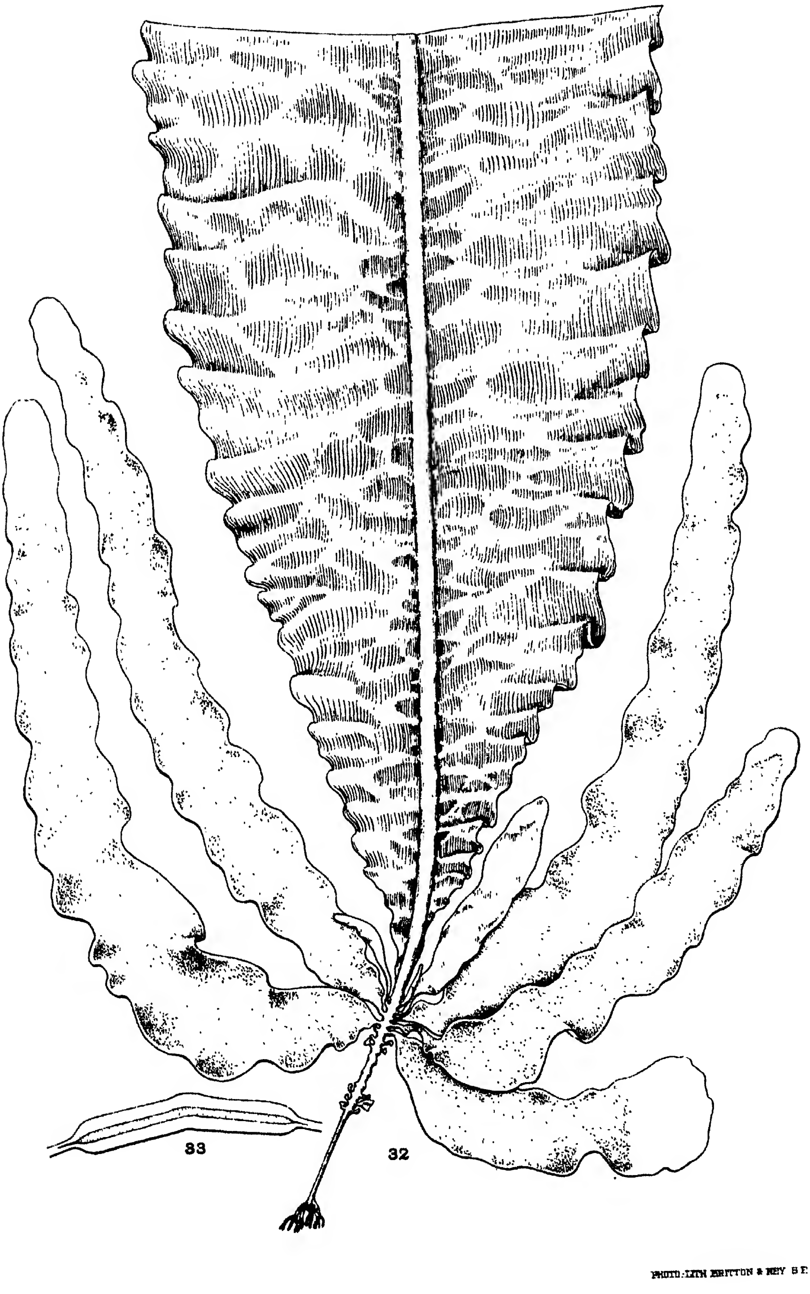

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PLATE 22.

Alaria tenuifolia Setchell.

34. Habit of the type of the species, No. 3286a, from Amaknak Island. This is a plant not fully grown. ($\times \frac{1}{2}$)

35. Cross section of the stipe 15 mm. above the base. ($\times 2\frac{1}{2}$)

36. Cross section 10 cm. above the base and 5 cm. below the beginning of the rhachis, to show the flattening. ($\times 2\frac{1}{2}$)

37. Cross section of the midrib. ($\times 2\frac{1}{2}$)

All the figures were drawn by H. N. Bagley, under the direction of W. A. Setchell.

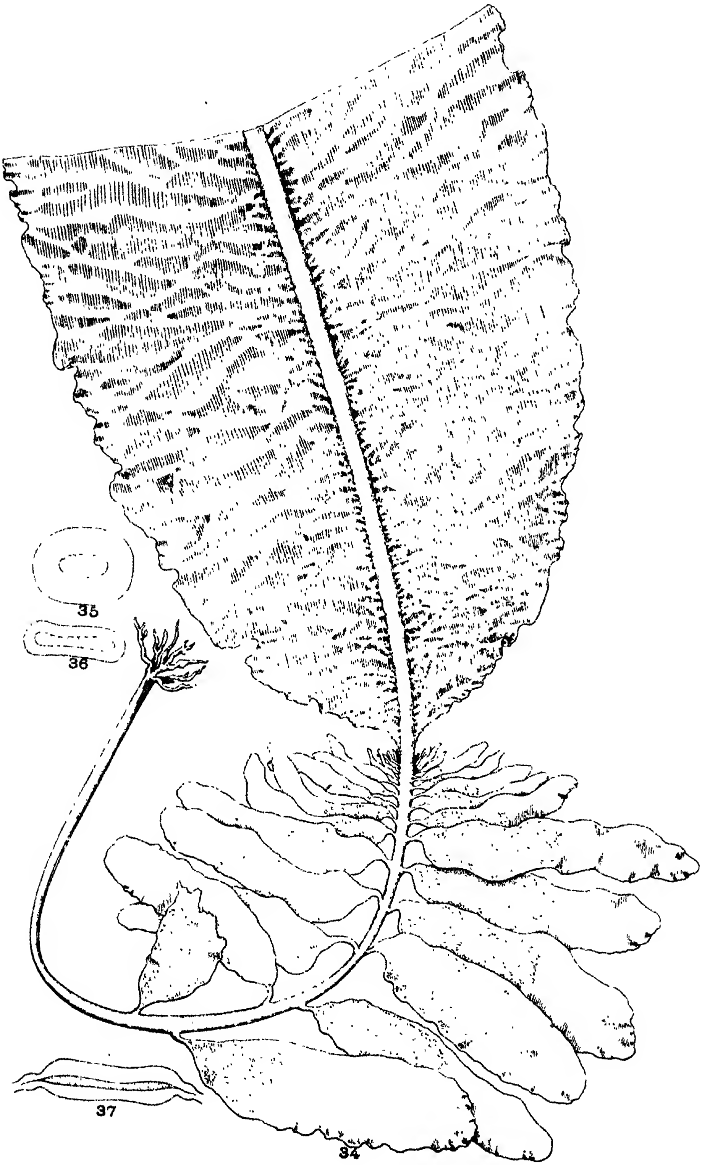

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PLATE 23.

Whidbeyella cartilaginea Setchell and Gardner gen. et. sp nov.

38. Habit of the type specimen. (× ½)

Anatheca furcata Setchell and Gardner sp. nov.

39. Habit of the type specimen. (nat. size)

Both figures were drawn by H. N. Bagley, under the direction of W. A. Setchell.

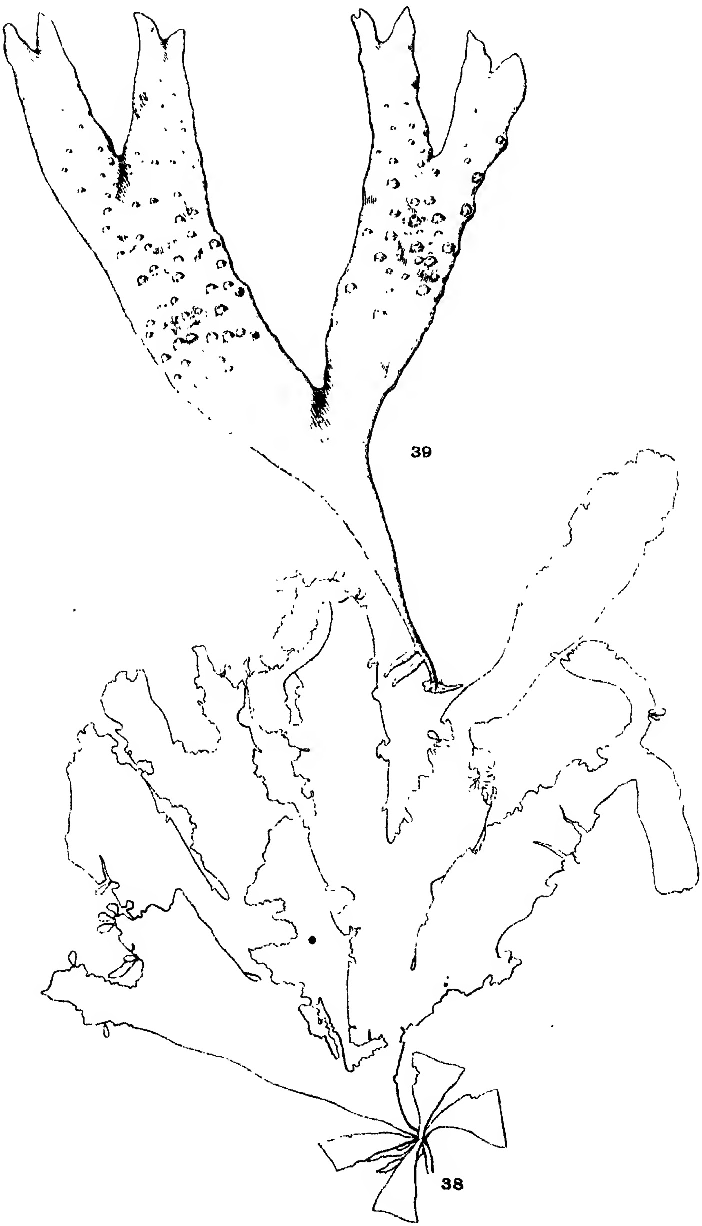

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PLATE 24.

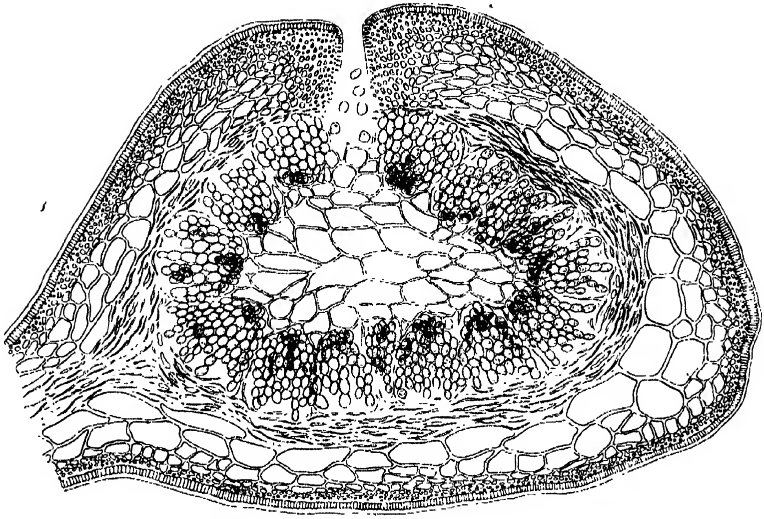
Whidbeyella cartilaginea Setchell and Gardner gen. et. sp. nov.

40. Cross section through the frond of the type specimen, showing the the structure of a young cystocarp. (Zeiss 2 × D)

Anatheca furcata Setchell and Gardner sp. nov.

41. Cross section through a cystocarp, showing the placenta, the masses of spores, and the filaments connecting the placenta with the tissues external to it. (Zeiss 2 × D)

Both figures were drawn by H. N. Bagley, under the direction of W. A. Setchell.



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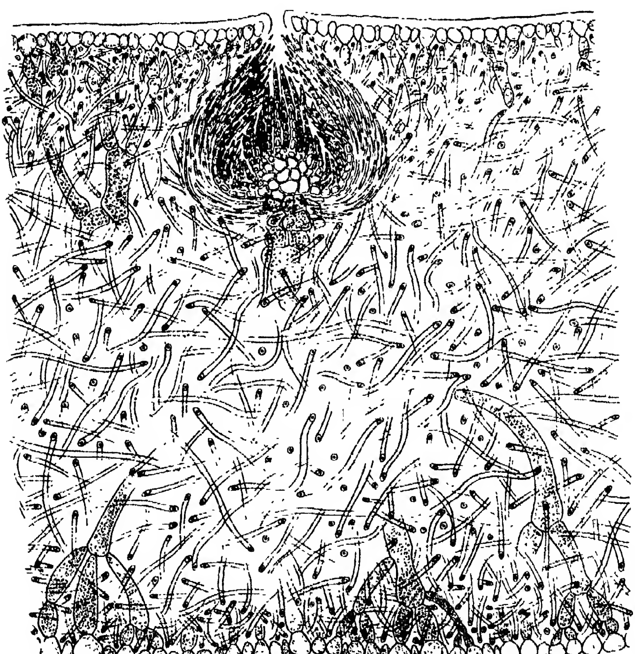

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PLATE 25.

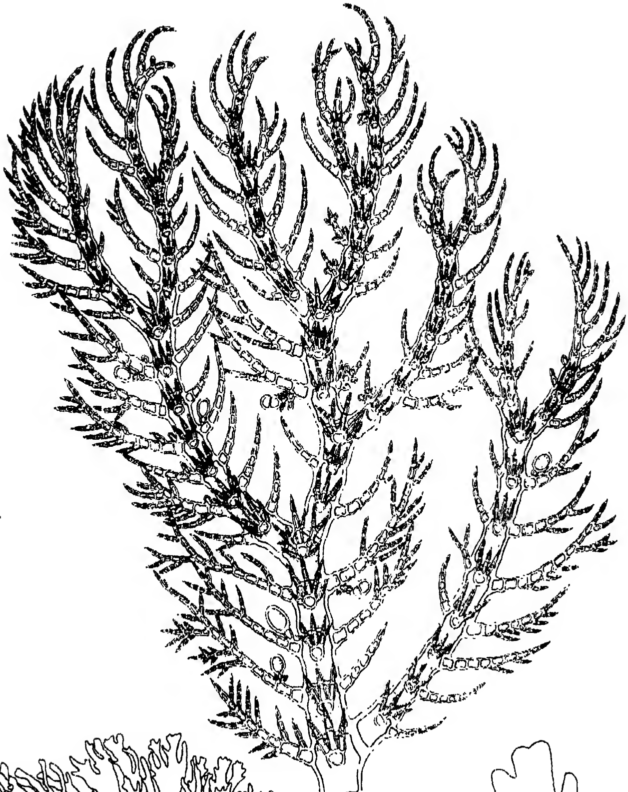
Platythamnion heteromorphum f. reversum Setchell and Gardner f. nov.

42. Portion of the tip of a plant from Whidbey Island, showing the arrangement of branches and branchlets. (Zeiss $2 \times$ D)

Fauchea laciniata J. Agardh.

43. Portion of a tetrasporic plant, showing the habit and the arrangement and shape of the sori. (nat. size)
44. Outline of a portion of a cystocarpic plant, showing the extreme of laciniate margin. (nat. size)

All the figures were drawn by H. N. Bagley, under the direction of W. A. Setchell.



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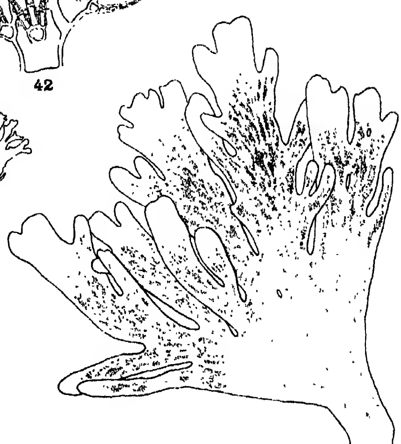

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PLATE 26.

Odonthalia semicostata (Mertens) J. Agardh.

45. Habit of sterile but characteristic plant from Whidbey Island. (nat. size)

Drawn by H. N. Bagley, under the direction of W. A. Setchell.

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PLATE 27.

Odonthalia semicostata (Mertens) J. Agardh.

46. Habit of a pinnule bearing cystocarps. Such pinnules are always more or less eroded. ($\times 1\frac{1}{2}$)
47. Portion of a cystocarpic glomerule. ($\times 5$)
48. Portion of a cystocarpic glomerule. ($\times 5$)
49. Portion of a tetrasporic glomerule. ($\times 10$)

Odonthalia floccosa (Esper) Falkenberg.

50. Pinna of an antheridial plant, showing the aggregation of the antheridial branchlets in a terminal glomerule. ($\times 5$)

Odonthalia Lyallii (Harvey) J. Agardh.

51. Portion of a tetrasporic plant. (nat. size)
52. Tetrasporic pinnule. ($\times 5$)
53. Portion of a cystocarpic pinna. ($\times 3$)

All the figures were drawn by H. N. Bagley, under the direction of W. A. Setchell.

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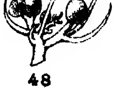

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